GAO XG2130 E1/Datacom Tester

USER'S MANUAL

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1 Overview

This chapter briefly describes the relevant icons, E1/Datacom tester overview, product compositions, functional keyboard, LED alarm and status indications and LCD icon indications in this operation manual.

1.1. Relevant icon information

1.2. Product overview

1.3. Product compositions

1.4. Functional keyboard

1.5. LED indicators

1.6. LCD icon indications

1.1 Icon Description

Some important information and items requiring special attention in this manual are described with following icons.

"Note" symbol: indicates some details that should be dealt with special caution when operating the instrument and reminds user's attention.

"Info" symbol: indicates some relevant information that user still need be told to know about after finishing some operating descriptions.

"Warning" symbol: indicates that user should refer to the manual instruction in order to protect the apparatus against damage.

The information after these icons in the operation manual must be noted to ensure the right and safe operation of this

instrument.

1.2 Product Overview

This E1/datacom tester is one multi-functional and full- featured digital transmission system test device, designed for the installation, engineering check and acceptance, daily maintenance of the digital networks, mainly performing bit error test, alarm analysis, fault finding and signaling analysis. In addition, the E1/Datacom tester further provides various commonly used protocol converters with one-directional and bi-directional bit error test function. This instrument mainly has following functions:

u ***E1 Testing:***

- 75Ω (Unbalanced) and 120Ω (Balanced) line interfaces
- HDB3 and AMI line codes
- Out-of-Service framed and unframed testing
  - ü 2Mb/s, N×64Kb/s BER testing
  - ü Frame data and alarm monitoring
    Frame data: FAS/NFAS, TS16 and timeslot data
    Alarm: Signal Loss, AIS, Frame Loss, Remote Alarm, Mframe alarm, Pattern Loss and BIT, CODE, FAS, E-BIT errors and so on.
  - ü Clock slip measurement
- In-service framed and unframed testing
  - ü Hi-Z and Through mode testing
  - ü CODE, FAS, CRC4 and E-BIT BER testing
  - ü Frame data and timeslot activity monitoring

- ü Built-in 64kb/s tone channel listen capability
- ü CAS and CCS signaling monitoring

- Round trip delay measurement
- APS delay measurement
- PCM simulator
  - ü Extensive alarm generation
  - ü Frame data Si, Sa, A, FAS, CRC-4, MFAS, NMFAS and E-BIT control and monitoring
  - ü Idle word timeslot insertion
  - ü VF tone generation and measurement
  - ü CAS and CCS signaling generation and monitoring
- Frequency, offset and level measurement
- Up to ±999ppm transmit clock deviation
- Transmit clock: Internal, Interface and External 2M clock/signal (option)
- Real time transmit circuit open/short indication

u ***Datacom Testing:***

- Datacom (V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A) BER testing
- Asynchronous BER testing with baud rate 50b/s～57.6Kb/s
- Synchronous BER testing with data rate 1.2Kb/s～38.4Kb/s and Nx64Kb/s(N=1～32)
- DTE or DCE emulation mode
- Synchronous clock source and sense selection

  Clock source: Internal or Interface

  Clock sense: Rising edge or falling edge

- **Frequency and offset measurement**
- **Handshaking signals control and monitoring**

u ***G.703 64kb/s CO Testing:***

- **G.703 CO 64kb/s BER testing**
- **Octet timing control and monitoring**
- **Frequency and offset measurement**
- **Transmit clock: Internal or Interface**

u ***Protocol Converter Testing:***

- **E1-Datacom synchronous 64kb/s, Nx64kb/s BER testing**
  Datacom interface: V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A
- **E1-G.703 CO synchronous 64kb/s BER testing**
- **One-directional data conversion BER testing**
- **Frequency and offset measurement of receive interface**
- **Handshaking signals monitoring of Datacom interface**
- **E1 frame data monitoring**

u ***Other Functions:***

- **Real-time clock**
- **Extensive LED/LCD alarm and status indications**
- **Test pattern: PRBS, Fixed Code and 16-BIT user word**
- **Error Injection: Single and Fixed Rate**
- **Manual and auto-timer measurement**
- **Histograms analysis of error and alarm events**
- **ITU-T G.821, G.826 and M.2100 performance analysis**
- **Self-test and keyboard testing**

- **Upgradeable software via an RS232C interface**
- **Up to 99 days continuance test performance**
- **More than 6 hours measurement operation from a single battery charge**
- **Save/Recall of up to 10 user-defined setups and results**
- **Test results could be uploaded, conserved and printed by TestManager software**
- **Built-in NiMH rechargeable can be charged with automobile cigarette lighter battery adapter**

1.3 Product Compositions

The E1/Datacom Tester is consists of following modules:

- **Hardware: Main board, Power board and Display board.**
- **Software: Embedded software and surveillance and management PC software "TestManager".**
- **Accessories: Waterproof package, Special test cables, AC power adapter, rechargeable batteries, automobile cigarette lighter adapter cable and so on.**

1.3.1 Appearance of the tester

- **Front panel: LCD display, LED alarm and status indicators, keyboard.**
- **Back panel: four disassembly-proof label, serial number label.**
- **Front end: E1 unbalanced signal input/output interface (L9 coaxial), DB-44 (Datacom signal input/output interface, E1 balanced signal input/output interface, E1 external clock/signal access interface, G.703 CO signal input/**

output interface), 12VDC input jack.

- Back end: end cover, slightly press the spring fins at the two sides of end cover to remove end cover. And the user can see battery compartment and RS232 port jack.

The appearance of the instrument is as shown in Fig 1.

1.3.2 Accessories of the tester

- Waterproof package
- E1 75Ω unbalanced test cable
- E1 120Ω balanced test cable
- G.703 CO test cable
- Datacom interfaces adapter cables
- Datacom interfaces loop-back adapter
- E1 external clock/signal access cable (option)
- AC power adapter
- RS232 communication cable
- Automobile cigarette lighter battery adapter cable
- AA NiMH rechargeable batteries
- TestManager setup CD
- User's manual

1.4 Functional Keyboard

The E1/Datacom tester has 16 functional keys at the front panel, including main functional keys, softkeys, cursor keys, page keys, a backlight key, a power switch key, a start/stop key, a single error insert key, etc. The arrangement of functional keys and names of keys from left to right are as shown in Fig 2. These functional keys are described as in Table 1.

Fig 1: Appearance of E1/Datacom tester

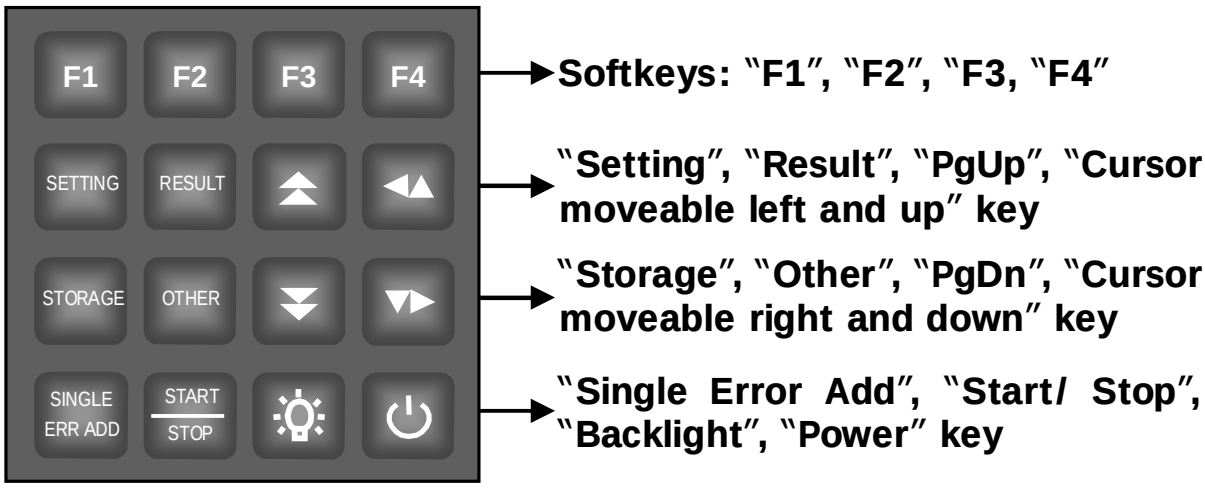

Fig 2: Functional keyboard

The right key-stroke leads to one beep while wrong or invalid key-stroke leads to two beeps. As prompt, there will be relevant hint information in LCD display at the same time.

Key Name	Description
Softkeys	Identified as "F1" to "F4", used to select the parameter or activity in corresponding highlight place at the bottom of LCD. Each LCD display defines one or more functions of these softkeys.
"Setting"	Matched with the "Settings" menu. When this key is pressed, LCD display switches to the "Settings" menu.
"Result"	Matched with the "Results" menu. When this key is pressed, LCD display switches to the "Results" menu.
"Storage"	Matched with the "Storages" menu. When this key is pressed, LCD display switches to the "Storages" menu.
"Other"	Matched with the "Others" menu. When this key is pressed, LCD display switches to the "Others" menu.
"Single Error Add"	When the tester is set as single error insertion mode, every time this key is pressed, one error of the set type will be inserted in the transmit direction.

"Start/Stop"	Manually control the start or stop activity of the test. Press it to start the test and press it again to stop the test.
"Page Up"	When page number appears in the display menu (Like "P1", indicates that display menu has more pages in all and is on page 1 currently), press this key to go page up.
"Page Down"	When page number appears in the display menu (Like "P1", indicates that display menu has more pages in all and is on page 1 currently), press this key to go page down.
"Cursor Moveable Left and Up"	Move the cursor upward and leftward and the cursor can reach the position with "[ ]".
"Cursor Moveable Right and Down"	Move the cursor downward and rightward and the cursor can reach the position with "[ ]".
"Backlight"	Turn on or off the LCD backlight according to the light condition.
"Power"	Switch on or off the tester.

Table 1: Functional keys descriptions

1.5 LED Indicators

The E1/Datacom tester has 12 status and alarm LED indicators in all, including 2 status indicators and 10 alarm indicators, mainly indicating the current operating status of instrument and

if any alarm is detected during the test process. The arrangement of the status and alarm LED indicators is as shown in Fig 3.

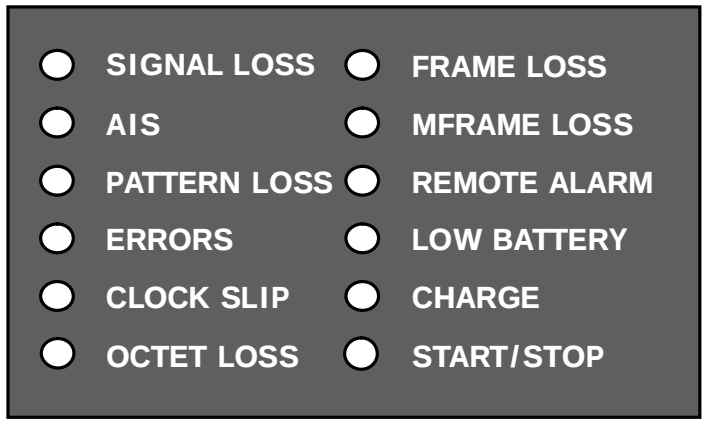

Fig 3: LED Indicators

Status and alarm LED indicators are described as in Table 2.

LED Name	Description
START/ STOP	As "Start/Stop" key keeps changing status, this indicator turns on (green) when the test is started and turns off when the test is stopped.
CHARGE	The tester has built-in rechargeable batteries and a rapid-charging circuit. This indicator turns on (orange) when the tester is under charging and turns off when it is fully charged.
SIGNAL LOSS	Effectively indicates a loss of signal. When the receiver detects 255 consecutive 0s, an alarm is generated and this indicator turns on (red). Alarm cleans on detecting at least 32 1s in consecutive 255 bits and LED turns off. (Comply with ITU-T G.775 / G.962)

AIS	Alarm happens on receiving less than 3 0s in 512 bits and cleans on detecting more than 2 0s in 512 bits and the LED will be turned off. (Comply with ITU-T O.162)
FRAME LOSS	Alarm happens on receiving 3 or more consecutive FAS words in error and LED turns on (red). Otherwise the alarm is cleaned and LED turns off. (Comply with ITU-T G.706)
MFRAME LOSS	Alarm happens on synchronization loss of CAS or CRC4 Multiframe and the LED turns on (red). Alarm cleans on both of these two alarms recovering and the LED turns off. CAS Multiframe Loss: Alarm on receiving 2 consecutive MFAS words in error and the LED turns on. Otherwise the alarm is cleaned. CRC4 Multiframe Loss: Alarm on receiving 915 or more CRC4 code words out of 1000 received in error and LED turns on. Alarm cleans on receiving 2 valid MF alignment words in 8ms.
PATTERN LOSS	Alarm happens on receiving 6 or more bits in error in consecutive 64 bits and the LED turns on (red). Otherwise the alarm is cleaned and the LED turns off.
ERRORS	Alarm happens on detecting at least 1 error and the LED turns on (red). The error sources: BIT, FAS, CODE, CRC4 and E-BIT.

REMOTE ALARM	**Alarm happens on detecting Remote Alarm or Remote Multiframe Alarm and the LED turns on (red). Alarm cleans on both of two disappear and the LED turns off.** **Remote Alarm: Alarm happens on receiving 1 at Bit3 in 3 consecutive NFAS words and the LED turns on (red). Alarm cleans on receiving 0 at Bit3 in 3 consecutive NFAS words. (Comply with ITU-T O.162)** **Remote Multiframe Alarm: Alarm happens on receiving 1 at Bit6 of timeslot 16 in frame zero in consecutive multiframes and the LED turn on. Otherwise the alarm is cleaned.**
CLOCK SLIP	**Alarm happens on when one or bits have been added to or deleted from a received PRBS pattern, and the LED turns on (red). In out-of-service testing, when the test pattern is PRBS, a clock slip will be counted in seconds.**
OCTET LOSS	**Alarm happens on not receiving octet timing violations for 8 consecutive octets in G.703 CO testing and the LED turns on (red). Alarm cleans on the receipt of the first octet violation and the LED turns off. Only valid for G.703 CO testing.**
LOW BATTERY	**Alarms happens on the built-in NiMH battery's voltage has dropped to a low level without external power supply. And the LED turns on (red)**

	to prompt the user that an external power is needed. In case the instrument is powered by external power, the LED turns off soon.

Table 2: Descriptions of status and alarm indicators

1.6 LCD icon indications

The E1/Datacom tester has 5 LCD icons which are displayed at the upper right corner of the LCD and with different indications respectively. Various LCD icons are described in Table 3.

Icon type		Descriptions
Historical Errors or Alarms	T	When there have been historical errors or alarms happened during the elapsed time of one test, the icon flashes once every other second to prompt the user.
E1 Transmit Circuit Status	B	Icon flashes on detecting open status of E1 transmit circuit. Real time indicates to prompt the user the transmitter is not connected with the cable or the cable is open circuit or broken. This icon can be used to judge if the cable is properly connected or damaged.
		Icon flashes on detecting short status of E1 transmit circuit. Real time indicates to prompt the user the cable is in short status. This icon can be used to judge if the cable is properly connected or damaged.

Timer Testing Mode	½	Icon flashes on that the automatic test timer has been set and indicates the tester will start the automatic test function at the specified time. This icon displays in real time to prompt the user that the pre-determined timer has been set.
Status Lock	Ï	Icon flashes on that the configuration items in the "Settings" menu have been locked, or the storage capacity is full, or stored settings and results have been locked, to prompt the user that one test has been started and configuration items can not be modified any more, or the storage capacity is full, existing records have to be deleted firstly to save the new records, or that stored record has been locked and has to be unlocked firstly before it can be overwritten.
	Ð	Icon flashes on that the configuration items can be modified, the storage capacity is not full, stored records have been unlocked, to prompt the user that no test is running yet and all the configuration items can be modified; or storage capacity is not full and new

		records can be saved, or that stored record is under the unlocked status and can be deleted.
Clock Loss		Icon flashes on that no valid 2 MHz clock or 2 Mb/s signal is presented at E1 external clock receiver when selecting E1 transmit clock source as "External", or no valid clock signal is detected at the datacom receiver by the instrument when performing measurements with the datacom interfaces.

Table 3: Descriptions of LCD icon indications

2 Getting Started

This chapter briefly introduces the unpacking check, power supply, switching on, communication with PC and other attention points of the instrument.

2.1. Unpacking check

2.2. Power supply

2.3. Switch-on

2.4. Communication with PC

2.1 Unpacking Check

In order to safely transport, the E1/Datacom tester is packed with carton, and with all accessories,in a waterproof package.

Be sure not to connect this instrument to any signal cable carrying hazardous voltage!

Please check when receiving the product:

- **If the packing carton is impaired and if the appearance of the product is impaired;**
- **If the product and all its accessories are available.**
- **The product with the standard configurations is consists of following items, as shown in Table 4 :**

Optional Configuration:

If the E1 External Clock / Signal optional function is ordered, the hardware, software and its accessory (E1 External

Clock/Signal Access Cable) will be provided.

Item	Qua	Item	Qua
E1/Datacom Tester	1	Embedded Software	1
75Ω Unbalanced Test Cable	2	TestManager Setup CD	1
		AC Power Adapter	1
120Ω Balanced Test Cable	1	User's Manual	1
Datacom Adapter Cables	4	Waterproof Package	1
G.703 CO Test Cable	1	Maintenance Card	1
Datacom Interfaces Loop-back Adapter	1	Quality Certificate Card	1
RS232 Communication Cable	1	Packing list	1
Automobile Cigarette Lighter Battery Adapter Cable	1	AA NiMH Rechargeable Batteries (Built-in)	5

Table 4: Standard configurations of the E1/Datacom tester

Please check the product item by item according to the packing list. Please contact the supplier if anything is missing.

If necessary, keep the packaging materials in case they will be needed some time.

2.2 Power Supply

This instrument can be powered by external power supply or rechargeable batteries.

2.2.1 External Power Supply

The external power supply requires a power source of 110V to 240V AC at a frequency between 50Hz to 60Hz (nominal). And the tester requires a nominal DC supply of 12V. Plug the AC power cord into an appropriate AC wall outlet and connect the instrument with adapter cable. And the instrument can be powered by external power supply via the AC adapter.

2.2.2 Rechargeable Batteries

The rechargeable batteries will typically power the instrument for more than 6 hours with the backlight off and Bit Error measurement selected. The instrument uses 5 high-performance 1800mAH Nickel Metal Hydride (NiMH) rechargeable batteries placed in the battery compartment that may not be fully charged when the user receive the instrument. Whatever the state of charge, use the instrument the battery is completely exhausted before giving it its first charge. This will ensure better accuracy from the battery charge indicator.

Do not change battery model!

Do not use old and new rechargeable batteries together!

Do not use non-rechargeable battery, in case that may be cause the battery explosion or other danger!

Replacement of Rechargeable battery

A new rechargeable battery can be charged and discharged for about 800~1000 times before it can not be used any more. Normally the fully charged batteries could support the instrument continuous 6 hours working depending upon the test settings. So when the operating duration of the battery is apparently reduced, the batteries should be replaced.

We suggest that the rechargeable batteries should be replaced every one or two years!

Method of Battery Replacement:

Ensure the instrument is switched off firstly. And open the end cover of the instrument and slightly press the battery compartment lock card downward, the battery case will pop out. Extract the battery compartment and unscrew the screws on the top of the case to open and replace new batteries (Be careful of not mistaking the polarity of the battery). When the battery compartment has been loaded again, slip it back into the battery case frame and push the battery compartment inside (Put your fingers upon the case rather than the battery case lock card), the battery case is installed well while a "click" sound is heard. The battery replacement is completed when the end cover of the instrument is mounted again.

When the batteries supplied for this instrument have been expired the charging life or are impaired, they

should be dealt with control. If dealt with general waste processing system or detained in the instrument, they will harm the environment. The waste batteries should be recycled or disposed of properly at special recycling station or hazardous waste collection center.

2.2.3 Charging the Battery

To recharge the battery, plug in the charger using an appropriate adapter (supplied). Normally the battery will be fully charged after 2.5 hours. In exceptional circumstances where the battery may have become deeply discharged, a charge time of 24 hours may be required. Note that the instrument can be used while the battery is charging. During rapid charging, the "Charge" indicator turns on. When the rapid charging is completed, charging automatically turns into a trickle charge, the "Charge" indicator turns off. The instrument certainly can be recharged when it is powered off, the charging indicator can give the right display.

In addition, the battery can be recharged with automobile charger, at this time an automobile cigarette lighter adapter cable is needed.

2.2.4 "Low Battery" Indication

When being powered by the battery, this instrument can give the early alarm to low battery voltage and the "Low Battery" indicator turns on. After being used for a couple of hours, the battery voltage continues to drop to a low level, and the instrument will automatically perform protective shutdown.

When the "Low Battery" indicator turns on, the external power supply is needed to support the instrument working while the battery is charging.

2.2.5 Power Management

This instrument provides automatic power-off function. When the instrument is not under test-started status and there is no keystroke in 5 minutes, this instrument will be turned off automatically. This function can effectively prevent the instrument from being accidentally turned on and the battery from being exhausted during transport. This function can be set to ON or OFF in "Others" menu.

The LCD backlight can be turned on by pressing the "Backlight" key, and be automatically turned off in 30 seconds. This function can be set to ON or OFF in "Others" menu. When set as OFF, press the "Backlight" key to turn on the backlight, and press the "Backlight" key again to turn off the backlight.

2.3 Switch-On

2.3.1 Switch-on Inspection Steps

- Plug in AC adapter with power cord, the "Charge" indicator of this instrument will turn on;
- This instrument can be switched on after "Power" key has been pressed for about 1 second, LCD displays company's LOGO and the software version information embedded in the instrument. About 1 second later, the switch-on process is completed and LCD display the setting's menu

after one beep.

- This instrument can be switched off by pressing the "Power" key again for 1 second. When the battery has been fully recharged, remove the AC power adapter. After powering of battery, this instrument can be switched on or off by pressing the "Power" key.
- Loopback the 2Mb/s input and output interface of the instrument with E1 75Ω unbalanced test cable.
- Switch on the instrument and check if LCD displays and LED indicators are abnormal.
- Select error insertion type as "BIT", "Single", and press the "Single Err Add" key to check if the instrument detects and operates properly.
- When the user receives the instrument at the first time, please use the instrument until the battery is completely exhausted before giving it its first charge.

2.3.2 Setting the Time and Date

At the top line of the screen, LCD displays the current time, in the format of "Hour: Minute: Second", with 24-hour system. Because the test result is time-stamped, therefore it is necessary to set right time and date before using this instrument.

Time and date can be set in the real-time clock settings in the "Others" menu, by following operational steps:

- Press the "Other" key to switch to the "Others" menu, select TIME&DATE by the softkeys.

- Select SETUP to "Clock Mode" item, and then the date and time of the instrument can be modified.
- Choose the RUN status after date or time has been set, and then the instrument can work according to the newly setting time.

2.3.3 Self-test

Before making measurements, run a self-test to check that the instrument is operating correctly. The user may find self-test function in the "Others" menu. Please refer to the "Others" menu descriptions for details.

2.4 Communication with PC

This instrument supports communication with PC via RS232C interface by TestManager software. And TestManager can do two jobs: one is to upload the test results stored in the instrument to PC for further processing including filing, printing and analyzing, and the other is to upgrade the embedded software via PC to protect your investment.

2.4.1 Communication Steps

- Switch off the instrument firstly.
- Open the end cover of the instrument.
- Connect RS232 interface of the instrument to PC serial port with RS232 communication cable (supplied).
- Switch on the instrument.
- Set RS232 port state to ON in "Others" menu.
- Run the TestManager software on PC, click "Select" to choose the type and click "Connect" icon. After the

successful connection the user can upload, view, analyze, delete, print test results in the form of report and do other operations.

Be sure not to plug and unplug the communication cable alive when connecting PC serial interface to the instrument using the serial communication cable, and be sure to ground or use ESD wrist strip. During serial data communication period, the instrument can be powered either by built-in batteries or by AC power adapter.

2.4.2 Upgrading the Embedded Software

We will launch the latest version embedded software and host software TestManager in the website of our company for the users to download. Make sure to visit our website frequently to ensure you will always get the software of the latest version.

For the software upgrading method, please refer to the relevant part of "Communication with PC" and follow instruction of the TestManager.

When performing the embedded software upgrading, in order to prevent the instrument powered off caused by the battery exhausted, it is strongly recommended to use external AC power supply to power the instrument.

3 Navigating the Displays

This chapter first briefly gives an overview of the four main operation menus, and then explains the relevant operations of these four main operation menus in details.

3.1 Menu overview
3.2 "Settings" menu
3.3 "Results" menu
3.4 "Storages" menu
3.5 "Others" menu

3.1 Menu Overview

The operation menus of the E1/Datacom tester includes "Settings", "Results", "Storages" and "Others" menu, matched with the "Setting", "Result", "Storage" and "Other" keys respectively. These four menus can be switched from one another at any time by pressing these four keys. "PgUp" and "PgDn" keys provide page up and down functions, "Cursor Right and Down" and "Cursor left and Up" keys provide cursor movement functions, "F1", "F2", "F3", "F4" softkeys are used to select the parameter or actions at the bottom of LCD which matched with the place highlighted by the cursor.

In each of display areas the field currently able to be changed is marked by a "Highlighted cursor". The menu of selection available for the active field is displayed on softkeys on the bottom of the display. The choice from the menu is made using the keys situated immediately below the display. The highlighted

cursor is moved around the display using page and cursor keys. When a highlighted field has more than 5 choices a softkey labeled >> is provided. When >> is chosen the remainder of the menu is revealed.

"Settings" menu

Press the "Setting" key to enter into the settings menu. Press the "Cursor Right and Down" and "Cursor left and Up" keys to move the cursor, press the "F1", "F2", "F3" and "F4" softkeys to select the corresponding parameters. In case page number appears in the menu, turn page by pressing the "PgUp" or "PgDn" key. Press the "Start/Stop" key to start the test after all the settings have already been configured completely.

"Results" menu

Press the "Result" key to switch to the result menu. "F1", "F2", "F3", "F4" softkeys are used to select various types of result analysis and statistics. In case page number appears in the menu, then page can be turned by pressing the "PgUp" or "PgDn" key.

"Storages" menu

Press the "Storage" key to switch to the storage menu. Press the "Cursor Right and Down" and "Cursor left and Up" keys to select storage name, press the "F1", "F2", "F3", "F4" softkeys to view, delete, lock, unlock, rename and other actions to the settings and results of the record. In the stored results, the

instrument setting and result information of any test result are available.

"Others" menu

Press the "Other" key to switch to the auxiliary information menus. Following auxiliary information menus can be accessed by pressing the "F1", "F2", "F3" and "F4" softkeys, including miscellaneous, power manager, time & date, RS232 port, keyboard test, self-test, tester information, producer information and so on.

Status prompt information line provides operating status of the instrument.

The upper right corner of LCD "Đ" indicates that the parameters can be modified, "Ï" indicates that the instrument is doing one test, softkeys are under the lock status, and configuration data can not be modified. "Đ" in the storage menu indicates that there still has storage space to save more records in the instrument, "Ï" indicates that no saving space is available, some records must be deleted first to save the new records. "Đ" and "Ï" following each saved record respectively indicate that the record is under locked or unlocked status.

3.2 "Settings" Menu

"Settings" menu mainly performs the selection of the test function and the settings of relevant parameters, which are associated with the situation of the system under test. Only after

setting relevant parameters and performing the correct test connections can be the test process accomplished properly.

Every time the instrument is switched on again, the instrument automatically uses the settings menu of the last valid test as the default setting menu. Only the start-stop processing test can become one valid test.

Press the "Setting" key to switch to the "Settings" menu, the user can select E1, DATACOM, PROTOCOL CONVERTER, G.703 CO to set test functions. The parameters of settings may vary from function to function. And below will explain the settings respectively.

E1/Datacom tester, in case the instrument does not carry the G.703 CO module, its option will not show up in the "Function" option. And the user can not make the relevant measurements.

3.2.1 "E1" Settings Menu

3.2.1.1 "TX/RX" Mode

"TX/RX" mode mainly performs out-of-service framed or unframed bit error test to E1 transmission networks. The display is shown as Fig 4. The settings may be changed by framing format selection. The settings of relevant framing are described in Table 5. The settings of relevant PCM30, PCM30CRC, PCM31 and PCM31CRC are shown in Appendix A: "E1 Frame Structure".

a. "TX/RX" Mode Unframed Settings

An unframed test pattern which internally generated is

transmitted by the transmitter of the instrument and is sent into the network under test. And this test pattern will be looped back to the receiver. The instrument makes bit error test and analysis based on the comparison of the transmitted and received data.

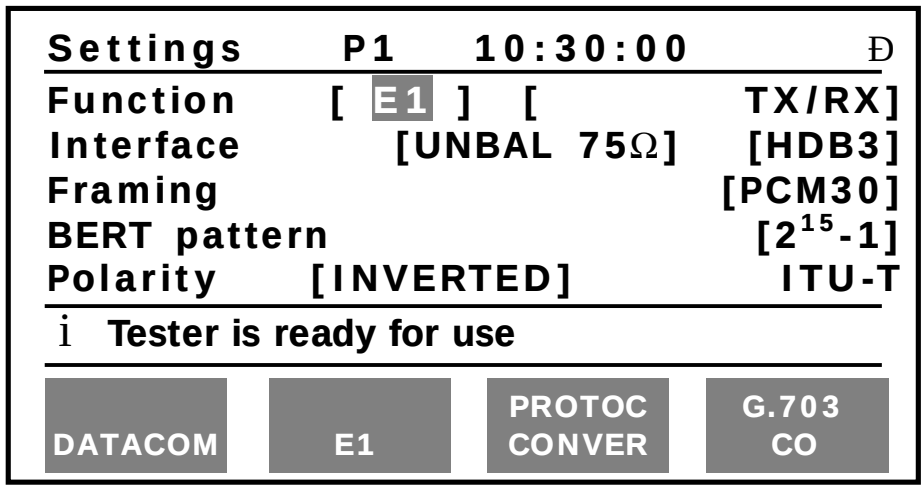

Fig 4: Page 1 of "Settings" menu

Framing	Description
UNFRAMED	The "unframed" data is a 2.048Mb/s serial binary data stream without framing.
PCM30	Framed E1 with Channel Associated Signaling (CAS) multiframe.
PCM30CRC	Framed E1 with Channel Associated Signaling (CAS) and CRC4 multiframe.
PCM31CRC	Framed E1 with CRC4 multiframe.
PCM31	Framed E1 with no multiframe.

Table 5: "Framing" parameter settings

- Page 1 of "Settings" menu in "TX/RX" mode (unframed)

TX/RX unframed testing mode has 2 pages, with the page 1 as shown in Fig 5.

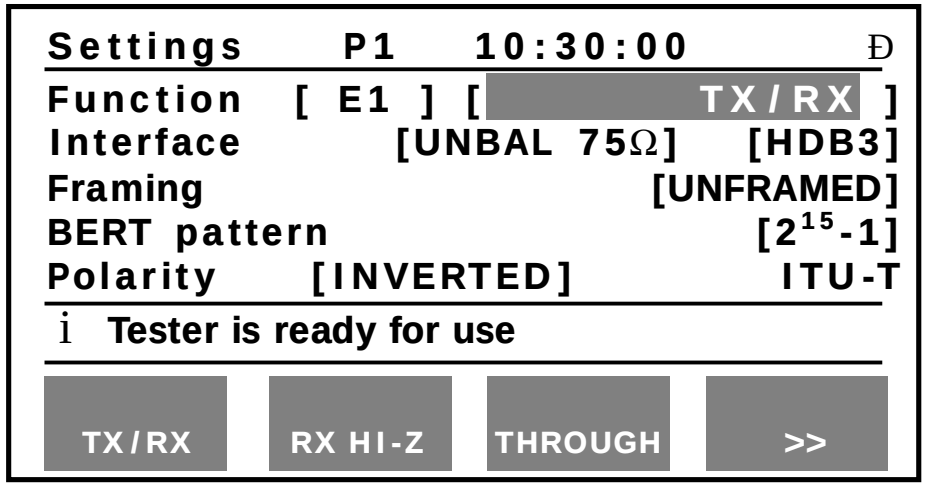

Fig 5: Page 1 of "Settings" menu in "TX/RX" (Unframed)

Under UNFRAMED mode, in page 1 of the settings menu, move the cursor to the parameter's positions corresponding to "Interface", "Framing", "BERT pattern", "Polarity", and select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys.

The setting parameters of "Interface" are described in Table 6. The settings parameters of "Framing" are described in Table 5. The setting parameters of "BERT pattern" and "Polarity" are described in Table 7.

Item	Option	Descriptions
Interface	UNBAL 75Ω	The line impedance is unbalanced 75Ω, connected with coaxial cable. The physical connector is L9.

	BAL 120Ω	The line impedance is balanced 120Ω, connected with twisted pair wires, the red cable transmits and the yellow cable receives the signals. The physical connector is crocodile clamp.
Line Code	HDB3	The line code is a High Density Bipolar 3 which is one of the commonly used line code to perform the base-band signal transmission in the digital networks. HDB3 coding was adopted to eliminate the synchronization problems occurring with AMI. In HDB3 format, a string of four consecutive zeros is replaced with a substitute string containing an intentional BPV (Bi-Polar Violation).
	AMI	The line code is an Alternate Mask Inversion. AMI coding is used to represent successive 1s in a bit stream with alternating positive and negative pulses. A zero bit will not generate any pulse. AMI coding is not used in most E1 transmissions because of synchroni-zation loss during long strings of data zeros. (Note: "Signal loss" alarm will be generated when transmitting unframed all "0" in AMI code.)

Table 6: "Line Interface" parameter settings

Item	Option		Descriptions
BERT pattern	2^{23}-1	2^{15}-1	Pseudorandom Binary Sequence (PRBS) is suitable for bit error rate measurement.
	2^{11}-1	2^{9}-1	
	1111		Fixed code or static binary code can simulate AIS (1111) and etc.
	0000		
	1010		
	16BIT		16-BIT is a user programmable word.
Polarity	NORMAL		The instrument transmits and receives PRBS code according to the normal "1" or "0" polarity. Code "1" is transmitted as "1", and code "0" is transmitted as "0".
	INVERTED		The instrument transmits and receives PRBS code according to the reverse polarity. Code "1" is transmitted as "0", and code "0" is transmitted as "1".

Table 7: "Test Pattern" and "Polarity" parameter settings

Note, when performing measurements between two testers and the test pattern polarity transmitted is not confirmed, the user could switch to the reverse pattern.

- **Page 2 of "Setting" menu in "TX/RX" mode (unframed)**

Press the "PgDn" key to enter into the page 2, as shown in Fig

6. Press the "Cursor Right and Down" key to move the cursor to the positions to set "Transmit clock", "Error add", "Resolution", "Storage" and "Duration" parameters, and select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys.

The setting parameters of "Transmit clock" are described in Table 8. The setting parameters of "Error add" are described in Table 9a and Table 9b. The setting parameters of "Resolution", "Storage" and "Duration" are described in Table 10.

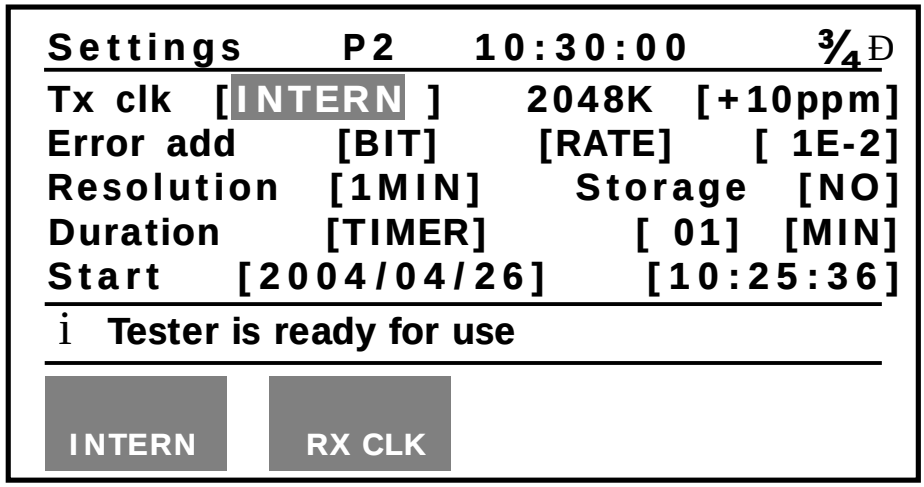

Fig 6: Page 2 of "Settings" menu in "TX/RX" (Unframed)

Item	Option	Descriptions
Tx clk	INTERN	Default. The transmit clock sourced from the internal crystal.
	RX CLK	The transmit clock is derived from the received signals at the receiver.

	EXTERN 2Mb/s clock (Option)		Optional. The transmit clock is derived from the external 2.048MHz clock signal which complied with TTL standard electrically, i.e., the 2MHz square wave signal input, as the transmit clock source, the yellow cable is connected to the clock signal and the black cable is connected to signal ground.
	EXTERN 2Mb/s signal (Option)		Optional. The transmit clock is derived from the external standard 2Mb/s HDB3 signal which is accessed with 75Ω coaxial L9 connector through the special access cable.
Frequency deviation	+10 PPM	+1 PPM	The internal clock can be deviated in the range of ±999ppm with the step length of 1 ppm. One application of this function is to test the clock recovering capability in receive circuit of the multiplexer under test.
	-10 PPM	-1 PPM	

Table 8: "Transmit clock" parameter settings

Item	Option	Description
Error add type	BIT	Insert bit errors. (Effective under various of unframed and framed testing)
	FAS	Insert Frame Alignment Signal (FAS) errors. (Effective only under the framed testing)
	CODE	Insert CODE errors. (Effective only under the AMI line code type)
	CRC4	Insert CRC4 errors. (Effective only under the framed testing with CRC4 frame structure)
	E-BIT	Insert E-BIT errors. (Effective only under the framed testing with CRC4 frame structure)

Table 9a: "Error add type" parameter settings

Item	Option	Description
Error add	SINGLE	Press the "Single Err Add" key on the keyboard to inject one error per time. Every time this key is pressed, one error such as BIT, FAS, CODE, E-BIT, CRC4 is inserted by the transmitter. "ERRORS" indicator turns on for one time with a second update.
	RATE	Errors are injected at the constant fixed rate such as 1E-2, 1E-3, 1E-4, 1E-5, 1E-6, 1E-7. In the mean time the "ERRORS" indicator turns on.
	OFF	Errors insertion is forbidden and pressing the "Single Err Add" key is invalid.

Table 9b: "Error add" parameter settings

Item	Option	Description
Resolution	1MIN	The time resolution to record the happening time of errors and alarm in the stored event records for the histogram analysis.
	15MINS	
	1HOUR	
Storage	YES	Save the test result. The menu to save the result will pop out when the test is completed.
	NO	The test result is not saved directly, and the user can save it later in the "CURRENT" item of "Storages" menu.
Duration	MANUAL	The test period is controlled by the "Start/Stop" key.
	AUTO	User-defined duration. Test period is initiated by pressing the "Start/Stop" key and normally terminates at the end of the period but this can be overridden by the "Start/Stop" key. According to actual needs, the time range can be set from 1 second ~ 99 days.
	TIMER	Run a timed test by programming both the start and stop time of this test. The test will automatically start and stop at the pre-determined time. And

		the test time range can also be set from 1 second ～ 99 days, and the start time can be set in the format of Y/M/D and H/M/S. In case that the pre-determined time is earlier than the real-time clock of the instrument, the test of pre-determined time does not work, this can be overridden by the "Start/Stop" key; If later than the current time, the pre-determined time works, user is not able to manually start the test, but can stop the test in advance manually.

Table 10: "Resolution", "Storage" and "Duration" settings

b. "TX/RX" Mode Framed Settings

The framed testing is intended to perform the bit error test of N×64kb/s (N=1～31) in E1 timeslots. This testing can make the accurate assessment of transmission performance in the selected one or more timeslots.

Select with the framed structure such as PCM30, PCM30CRC, PCM31, PCM31CRC. There are 3 setting pages in "TX/RX" mode, among which the setting contents of page 1 and page 3 are as same as ones in the unframed testing setting menus.

- Page 1 of settings menu in "TX/RX" mode (framed):

Refer to the relevant parts in page 1 of the settings menu in

"TX/RX" mode (unframed testing).

- Page 2 of settings menu in "TX/RX" mode (framed)

Press the "PgDn" key to enter into page 2 of settings menu in "TX/RX" mode (framed testing), move the cursor to the positions to set "Tx/Rx timeslots", "Idle pattern" parameters, as shown in Fig 7. The relevant parameters to select are described in Table 11.

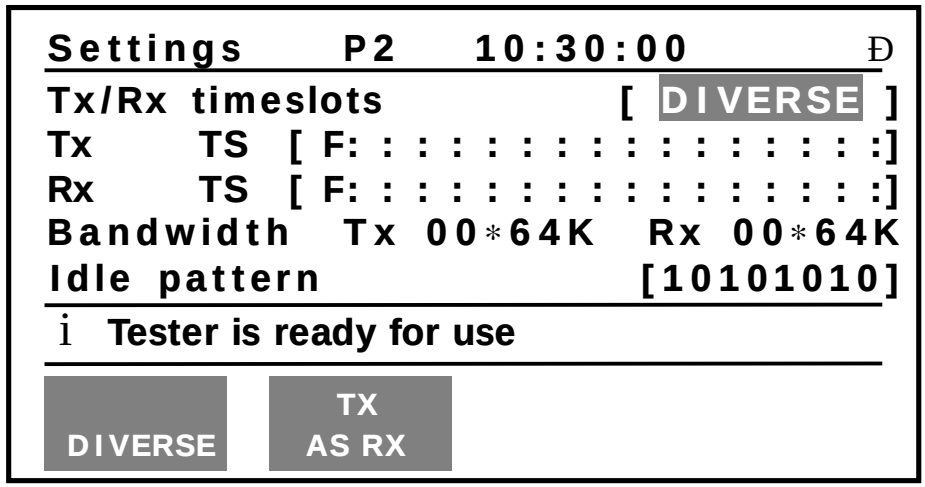
Settings P2 10:30:00
Tx/Rx timeslots [DIVERSE]
Tx TS [F: : : : : : : : : : : : : : : :]
Rx TS [F: : : : : : : : : : : : : : : :]
Bandwidth Tx 00*64K Rx 00*64K
Idle pattern [10101010]
Tester is ready for use
DIVERSE
TX AS RX

Fig 7: Page 2 in "TX/RX" mode (framed testing)

- Page 3 of settings menu in "TX/RX" mode (framed testing)

Refer to the descriptions of relevant parts in page 2 of settings menu in "TX/RX" mode (unframed testing).

Item	Option	Description
Tx/Rx timeslots	DIVERSE	The selected timeslots in the transmit direction are different to the ones in the receive direction.

	TX AS RX		The selected timeslots in the transmit direction are same as the ones in the receive direction.
Timeslot status	SELECT		To select or de-select a timeslot. The selected timeslot is marked with "*" and unselected one is marked with ".".
	DE-SELECT		
	¬	®	Move leftward or rightward to the timeslot that needs to be selected or de-select.
Band-width	No option		Displays the bandwidth of the transmit direction and the receive direction in real time according to amount of the timeslots selected respectively.
Idle pattern	1	0	Except the timeslot 0 and timeslot 16 in PCM30/30CRC frame, other not selected timeslots data will be replaced by idle codes on a per-channel basis on the transmit direction. This can be effectively used to detect the busy or idle activity of the timeslots. Note: Be sure not to set all idle codes as all "0" under AMI line code function.
	¬	®	Move leftward or rightward to the bit that needs to be edited.

Table 11: "Tx/Rx timeslots" and "Idle pattern" settings

3.2.1.2 "RX HI-Z" Mode

a. "RX HI-Z" Unframed Settings

Firstly choose the "Function" of the instrument as "RX HI-Z" as shown in Fig 8. Press the "Cursor Right and Down" key to select E1 framing as UNFRAMED. When user set the timer to start the test, there will have 2 pages of settings menu in "RX HI-Z" mode unframed testing, otherwise there has only 1 page. Move the cursor to the positions to set "Interface", "Framing", "Resolution", "Storage" and "Duration" parameters, and select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys. Above relevant parameters are described in Table 5, 6, 10.

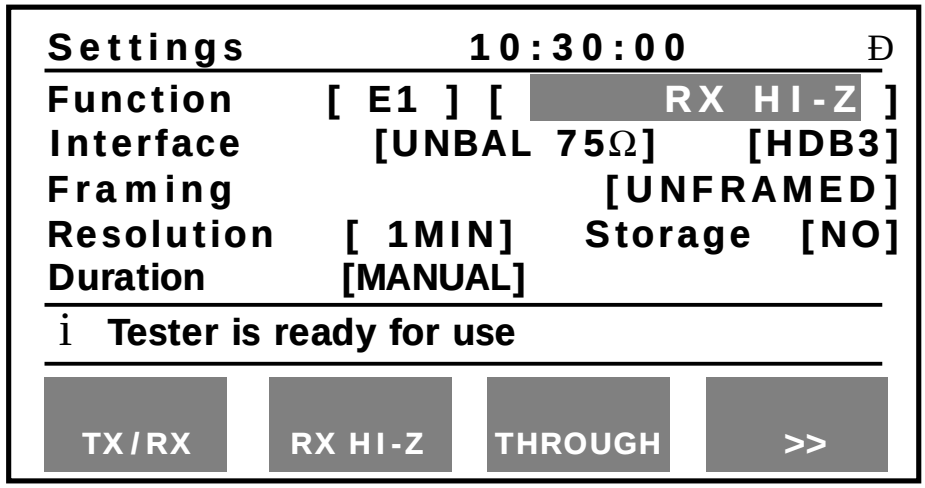

Fig 8: Settings menu in "RX HI-Z" mode (Unframed)

b. "RX HI-Z" Framed Settings

- Page 1 of settings menu in "RX HI-Z" mode (framed)

As shown in Fig 9, press the "Cursor Right and Down" key to select E1 frame as the framed structure. There have 2 setting pages in "RX HI-Z" mode framed testing, as shown

in Fig 9 and Fig 10. In page 1, move the cursor to the positions to set "Interface", "Framing", "Idle pattern" "Resolution" and "Storage" parameters, and select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys. Above relevant parameters are described in Table 5, 6, 10, 11.

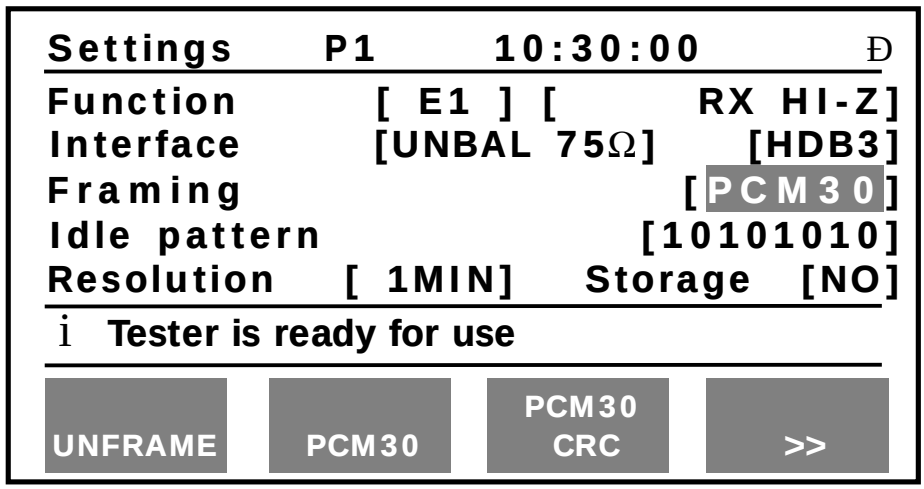

Fig 9: Page 1 of settings menu in "RX HI-Z" framed mode

- Page 2 of settings menu in "RX HI-Z" mode (framed)

Press the "PgDn" key to enter into page 2 of the settings menu in "RX HI-Z" mode framed testing, move the cursor to the positions to set "Duration" parameter, and select relevant parameters by pressing "F1", "F2", "F3", "F4" keys, as shown in Fig 10. And relevant parameters are described in Table 10.

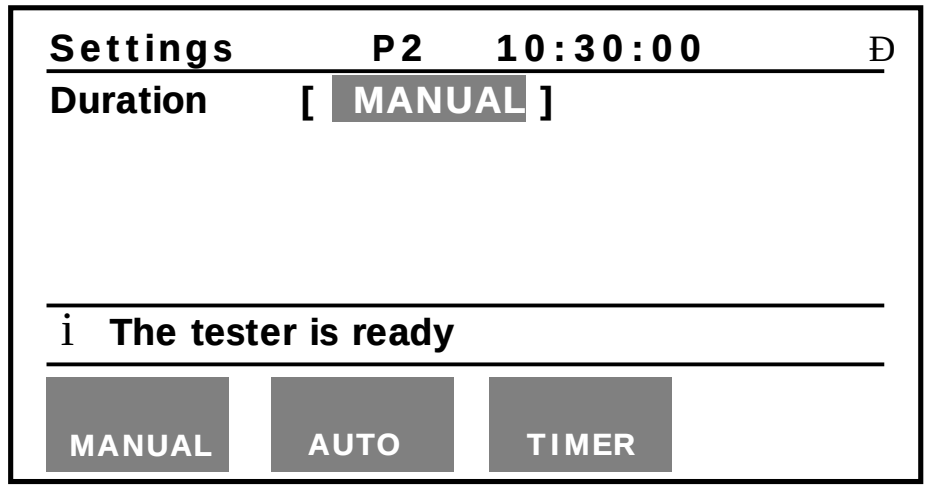

Fig 10: Page 2 of settings menu in "RX HI-Z" framed mode

3.2.1.3 "Through" Mode

"Through" mode testing supports the instrument is bridged as a "resistor" into an E1 path. In another word, E1 signal transmits through the instrument receiver transparently and to be relayed through the transmitter of the instruments. In this mode the transmitter and the receiver of the instrument must be connected into the E1 path, and the transmit clock of the instrument is always extracted from the received E1 signal to guarantee the synchronization of the signal. Because of the transparent transmission through the instrument, the instrument will not change the data of received E1 and make the measurements of error counting, frame data, signal and timeslot analysis.

Go back to page 1 of "Settings" menu, select THROUGH in "Function" item to set relevant parameters. All these parameter configurations are same as those in "RX HI-Z" mode.

3.2.1.4 "Loop Delay" Mode

The time taken for voice or data traffic to pass through network is very important as excessive delay adds distortion. Speech is particularly affected by delays longer than 150ms. "Loop delay" (Round Trip Delay) is a measurement of the total delay on the "go" and "return" legs of a duplex path and is typically in the order of milliseconds.

The instrument measure the time taken for a test pattern to be transmitted over the "go" and "return" legs of a duplex path. A test pattern is transmitted in an Nx64k b/s path or a 2Mb/s unframed path and a timer is set running. A loopback is manually applied to the network equipment to return the test signal. The received pattern stops the timer and the round trip delay is calculated in resolution of ±1μs.

Go back to page 1 of "Settings" menu, select LOOP DELAY in "Function" item to set relevant parameters, as shown in Fig 11. Different formats of frame set will have different settings. We will describe them below respectively.

a. "Loop Delay" Unframed Settings

As shown in Fig 11, press the "Cursor Right and Down" key, select "Framing" as UNFRAMED mode. There has one page of settings in this mode. And move the cursor to the positions to set "Interface" parameter and select relevant parameters by pressing "F1", "F2", "F3" and "F4" softkeys.

The settings of "Interface" and "Framing" parameters are

described in Table 6 and Table 5.

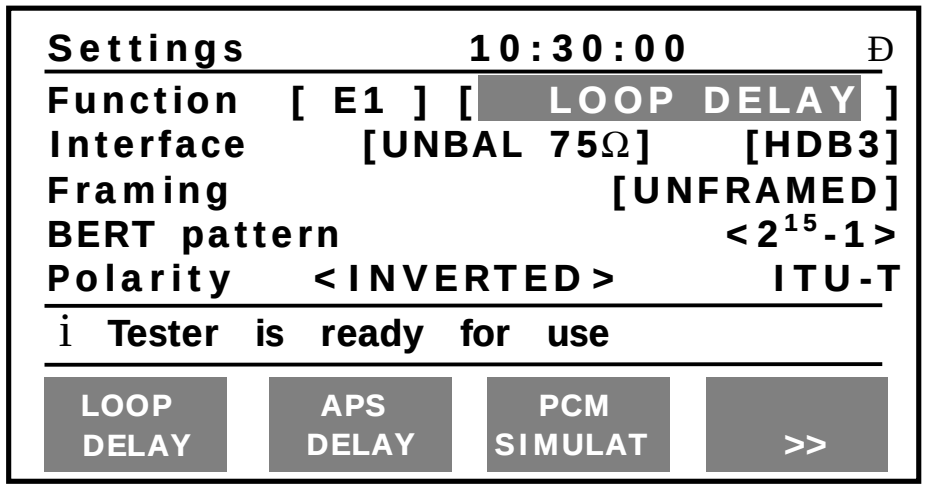

Fig 11: "Loop Delay" settings menu (Unframed)

b. "Loop Delay" Framed Settings

As shown in Fig 12, press the "Cursor Right and Down" key, select the framing formats of PCM30, PCM30CRC, PCM31, PCM31CRC. There have two pages of settings in this mode, as shown in Fig 12 and Fig 13.

- Page 1 of settings menu in "Loop delay" (Framed) mode

As shown in Fig 12, in page 1, move the cursor to the positions to set "Interface" and "Framing", and select relevant parameters by pressing "F1", "F2", "F3" and "F4" softkeys.

The settings of "Interface" and "Framing" parameters are described in Table 6 and Table 5.

- Page 2 of settings menu in "Loop delay" (Framed) mode

Press the "PgDn" key to enter into page 2 of the settings menu in "Loop delay" framed mode, as shown in Fig 13. Move the cursor to the positions to set "Tx/Rx timeslots" and other

parameters by pressing "F1", "F2", "F3" and "F4" softkeys.

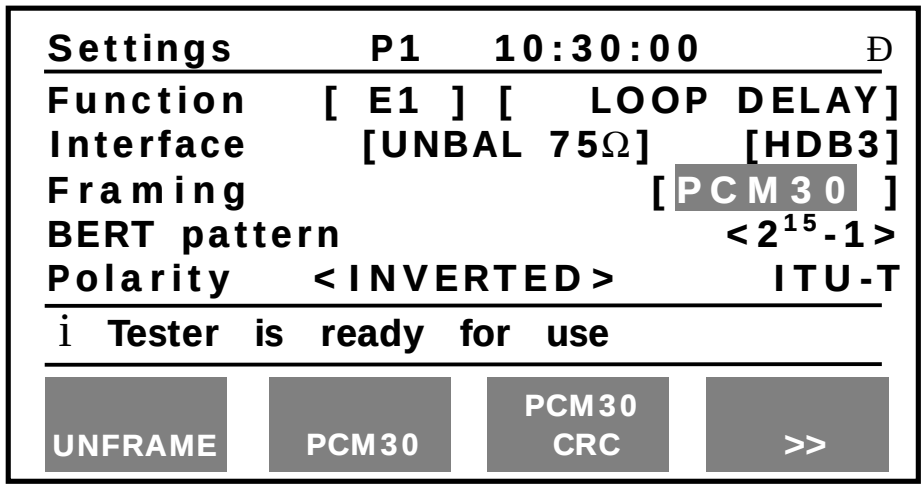

Fig 12: Page 1 of settings menu in "Loop Delay" (Framed)

The settings of "Tx/Rx timeslots" parameters are described in Table 11.

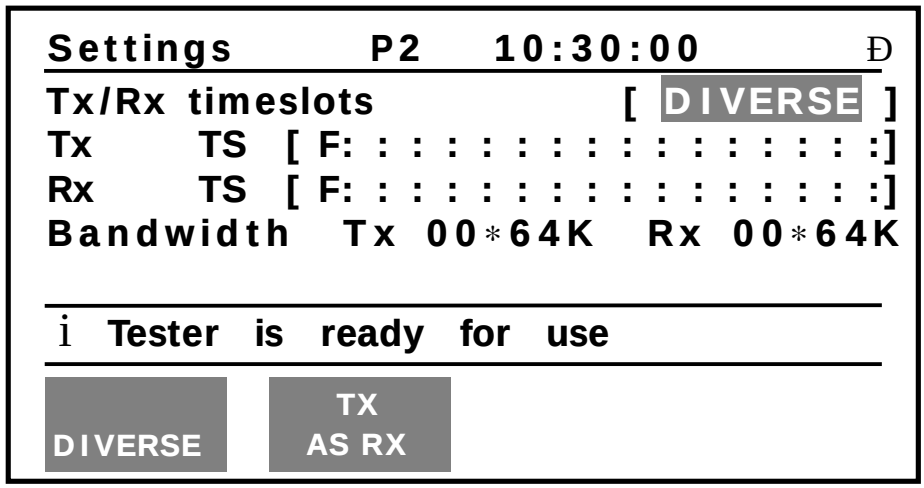
Settings P2 10:30:00 Đ
Tx/Rx timeslots [DIVERSE]
Tx TS [F: : : : : : : : : : : : : : : :]
Rx TS [F: : : : : : : : : : : : : : : :]
Bandwidth Tx 00*64K Rx 00*64K
i Tester is ready for use
DIVERSE
TX AS RX

Fig 13: Page 2 of settings menu in "Loop Delay" (Framed)

3.2.1.5 "APS Delay" Mode

The time taken for E1 signal transferring one to another transmission path is also very important to networks with E1 protection systems such as SDH. In these systems, once any of E1 links goes faulty while generating AIS alarm, the system

will automatically switch that E1 link to the other standby one. When the instrument received AIS alarm, a timer is started. After the detection of recovery from AIS, the timer will be stopped and the APS delay will be calculated in resolution of ±1μs. "APS Delay" is ideal for the assessment of the switching performance in SDH optical transmission or other networks.

Go back to page 1 of "Settings" menu, select APS DELAY in "Function" item to set relevant parameters. All these parameter configurations are same as those in "Loop Delay" mode.

3.2.1.6 "PCM Simulator" Mode

This instrument can make full simulation of PCM equipment, and perform comprehensive measurements to 2M b/s interface of the equipment. In "PCM Simulator" mode, the instrument provides transmit clock deviation, error insertion, alarm generation, framing bits and signaling programming. It can also support inserting idle codes and VF tone whose frequency and level are adjustable in one or more timeslots.

Go back to page 1 of "Settings" menu, select PCM SIMULAT in "Function" item to set relevant parameters. There are 2 pages of settings menu in this mode, as shown in Fig 14 and Fig 15.

a. Page 1 of "PCM Simulator" Settings

As shown in Fig 14, press the "Cursor Right and Down" key to move the cursor to the positions to set "Interface",

"Framing", "Tx clk", "Alarm injection" parameters, and select relevant parameters by pressing "F1", "F2", "F3" and "F4" softkeys.

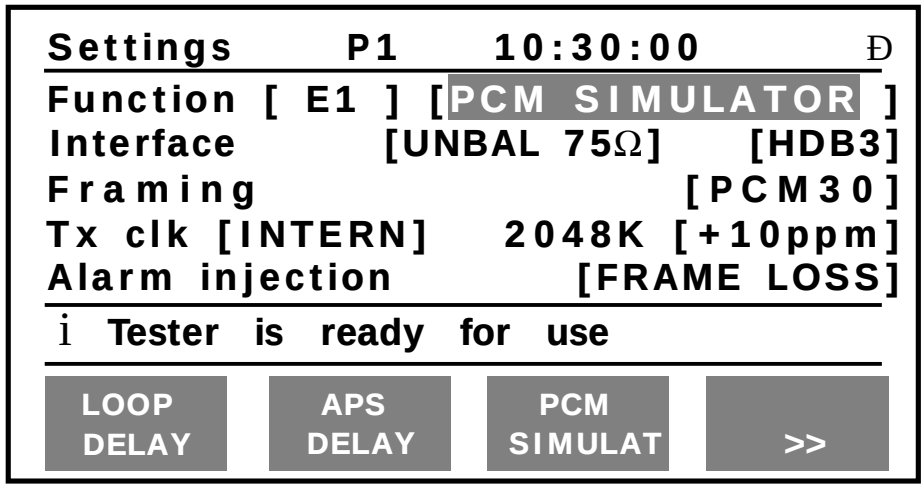

Fig 14: Page 1 of "PCM Simulator" settings menu

The settings of "Interface", "Framing" and "Tx Clk" parameters are described in Table 6, 5, 8 respectively. Since the framing data or framing synchronization may be destroyed after some alarms are injected, therefore some error insertion functions will be disabled accordingly. Error insertion type is also related with the frame format, as shown in Table 12. The settings of alarms insert ion parameters and insertion-permitted error types are described in Table 12.

b. Page 2 of "PCM Simulator" Settings

Press the "PgDn" key to enter into page 2 of "PCM Simulator" settings menu, as shown in Fig 15. Move the cursor to the positions to set "Error add", "TX FAS/NFAS", "TS16", "Signal Injection" and "Tx timeslots" parameters by pressing "F1", "F2", "F3" and "F4" softkeys. The settings of

relevant these parameters are described in Table 9a and 9b.

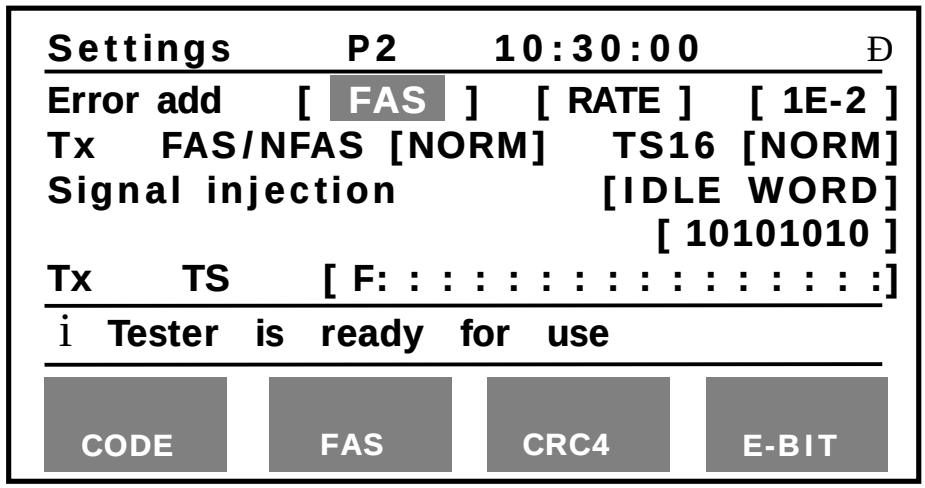
Settings P2 10:30:00
Error add [FAS] [RATE] [1E-2]
Tx FAS/NFAS [NORM] TS16 [NORM]
Signal injection [IDLE WORD]
[10101010]
Tx TS [F: : : : : : : : : : : : : : : :]
Tester is ready for use
CODE
FAS
CRC4
E-BIT

Fig 15: Page 2 of "PCM Simulator" settings menu

Option	Description	Error inserted
FRAME LOSS	The instrument transmits the wrong frame alignment signals to check if the equipment under test is able to give the corresponding alarm.	CODE
AIS	If the equipment under test can give AIS alarm when the instrument transmits AIS (all 1) alarm.	None
REMOTE ALARM	If the equipment under test can give the alarm when the instrument sets Bit3 of NFAS data in transmitted E1 data stream.	CODE FAS CRC4 E-BIT
CAS MF LOSS	If the equipment under test can give the alarm when the instrument transmits the wrong MFAS word. This	CODE FAS CRC4

	function is only effective in the frame structure with CAS.	E-BIT
CRC MF LOSS	If the equipment under test can give make the alarm when the instrument transmits wrong CRC4 word in NFAS. This function is only effective in the frame structure with CRC.	CODE FAS
REMOTE MF ALARM	If the equipment under test can give the alarm when the instrument transmits wrong NMFAS word. This function is only effective in the frame structure with CAS.	CODE FAS CRC4 E-BIT

Table 12: "Alarm Injection" parameter settings

The settings of "Tx FAS / NFAS" parameters are described in Table 13.

Option	Description
NORM	Transmit FAS and NFAS word according to the default settings of the instrument.
EDIT	The FAS and NFAS word can be programmed by user. An alarm may be generated if some relevant bits are changed. For instance, if A bit is set as "1", the equipment under test will generate remote alarm.

Table 13: "Tx FAS / NFAS" parameter settings

The "Tx FAS / NFAS" parameter settings will switch to various

menus according to the frame structure has benn set.

Note: you'd better not edit FAS or NFAS word when the alarm has already been inserted, otherwise the new alarms may be generated or existing alarm may disappear. In case of messy situation, please select NORM to restore default settings.

- When PCM30 or PCM31 framing is chosen, the user can set Si bits, A bit, Sa4-Sa8 bits in FAS and NFAS frame, as shown in Fig 16.

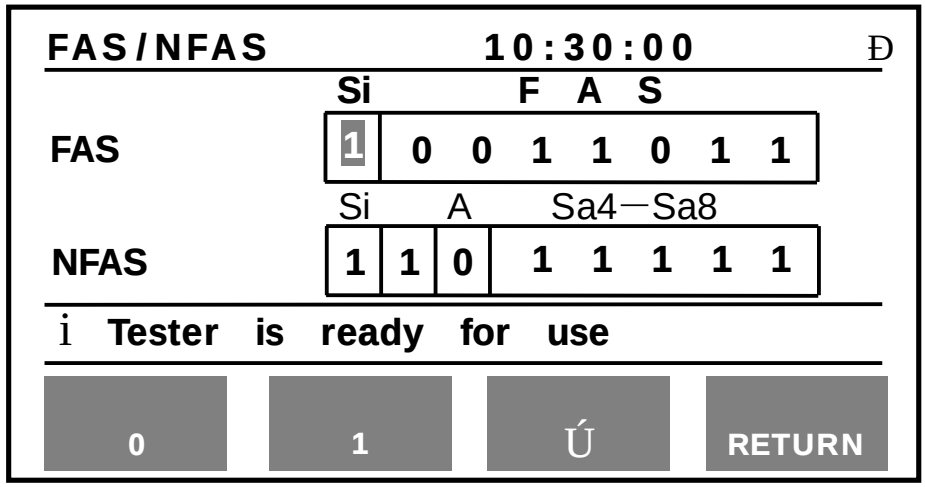

Fig 16: PCM30/31 "FAS/NFAS" edition

- When PCM30CRC or PCM31CRC framing is chosen, a CRC-4 Multiframe is formed. CRC MFAS provides synchronization of CRC4-Multiframe. The user can set Si bit in FAS frame, A bit, Sa4-Sa8 bits and C1-C4 bits in NFAS frame of F0～F15 sub-frames, as shown in Fig 17 and Fig 18.

The settings of "TS16" parameters are described in Table 14. "TS16" settings will be switched to different menus according

to frame structure.

- When PCM30 or PCM30CRC framing is chosen, CAS multiframe is formed. The Multiframe Alignment Signal (MFAS) provides synchronization of the signaling multiframe. The user can set MFAS, MNFAS bits and CAS (Channel Associated Signaling) signaling ABCD bits of TS1~TS31. There have 4 pages in all, as shown in Fig 19 and 20, (among which the settings from page 2 to page 4 are same, only the timeslot numbers are different). Note: do not set all ABCD bits of all 30 or 31 timeslots as "0000", otherwise the CAS Multiframe alignment will be lost.

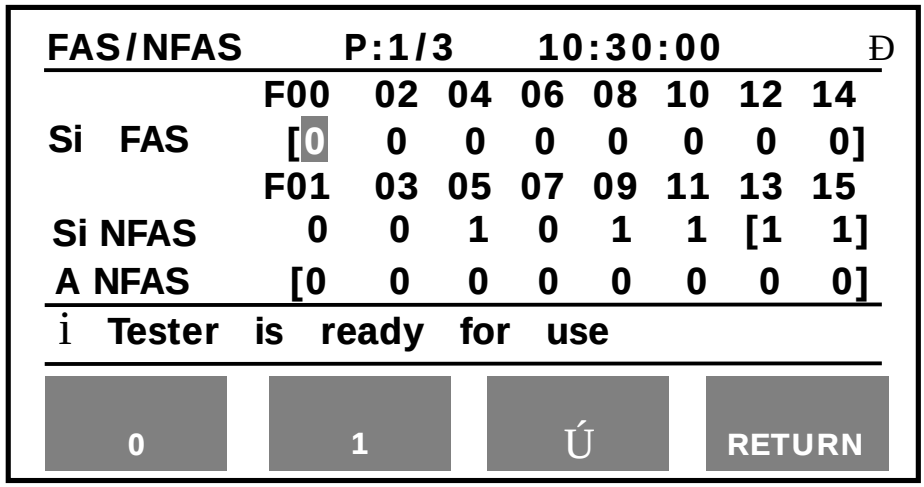

Fig 17: Page 1 of PCM30CRC/31CRC "FAS/NFAS" edition

- When PCM31 or PCM31CRC framing is chosen, no CAS multiframe will be formed. In CCS (Common Channel Signaling) frame, TS16 timeslot is used as normal data timeslot which can be used to transmit speech or data like other timeslots in E1 frame. Therefore, all the bits of TS16 timeslot can be programmed by the user in the form of F0～F16, as shown in Fig 21 and Fig 22.

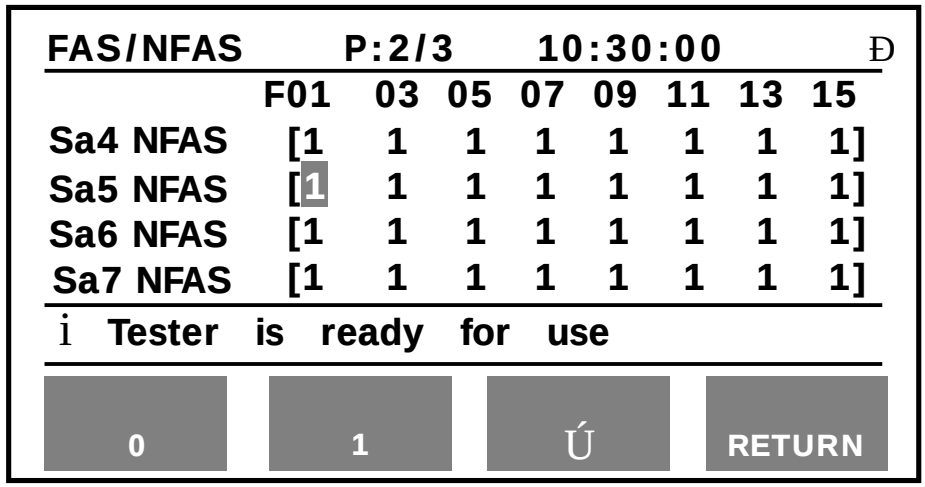

Fig 18: Page 2 of PCM30CRC/31CRC "FAS/NFAS" edition

Option	Description
NORM	Transmit the TS16 timeslot according to the default settings of the instrument.
EDIT	Bits of TS16 timeslot can be programmed by the user. An alarm may be generated if relevant bit is changed, if MFAS or MNFAS bit is changed, the equipment under test may be lose multiframe synchronization.

Table 14: "TS16" parameter settings

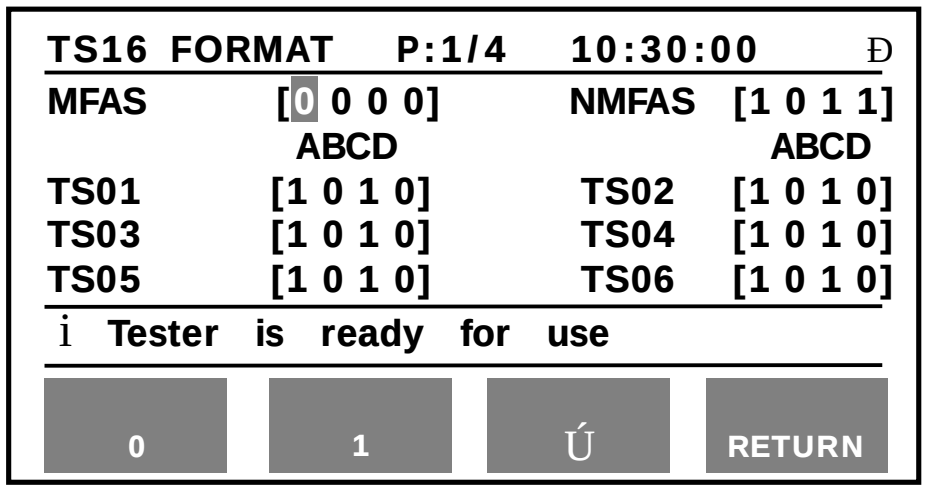
TS16 FORMAT P:1/4 10:30:00
MFAS [0 0 0 0] NMFAS [1 0 1 1]
ABCD ABCD
TS01 [1 0 1 0] TS02 [1 0 1 0]
TS03 [1 0 1 0] TS04 [1 0 1 0]
TS05 [1 0 1 0] TS06 [1 0 1 0]
Tester is ready for use
0
1
RETURN

Fig 19: Page 1 of PCM30/CRC "TS16" timeslot settings

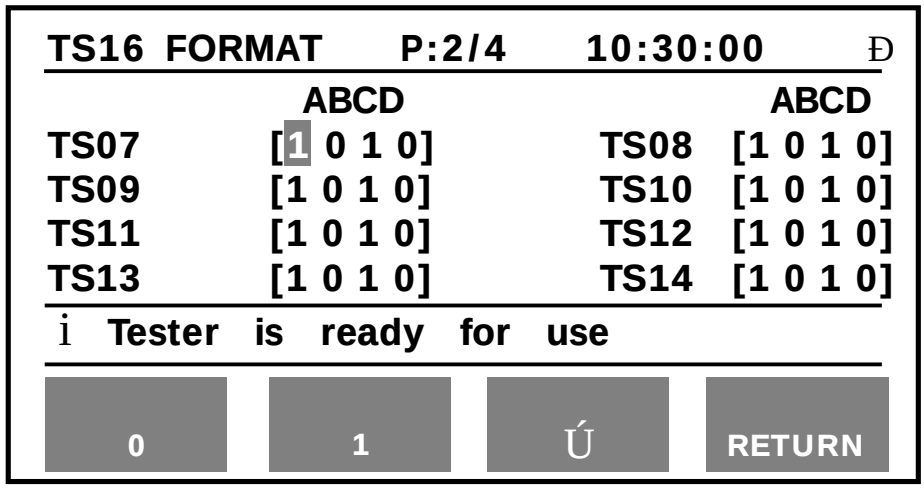
TS16 FORMAT P:2/4 10:30:00 Đ
ABCD ABCD
TS07 [1 0 1 0] TS08 [1 0 1 0]
TS09 [1 0 1 0] TS10 [1 0 1 0]
TS11 [1 0 1 0] TS12 [1 0 1 0]
TS13 [1 0 1 0] TS14 [1 0 1 0]
i Tester is ready for use
0
1
Ú
RETURN

Fig 20: Page 2 of PCM30/CRC "TS16" timeslot settings

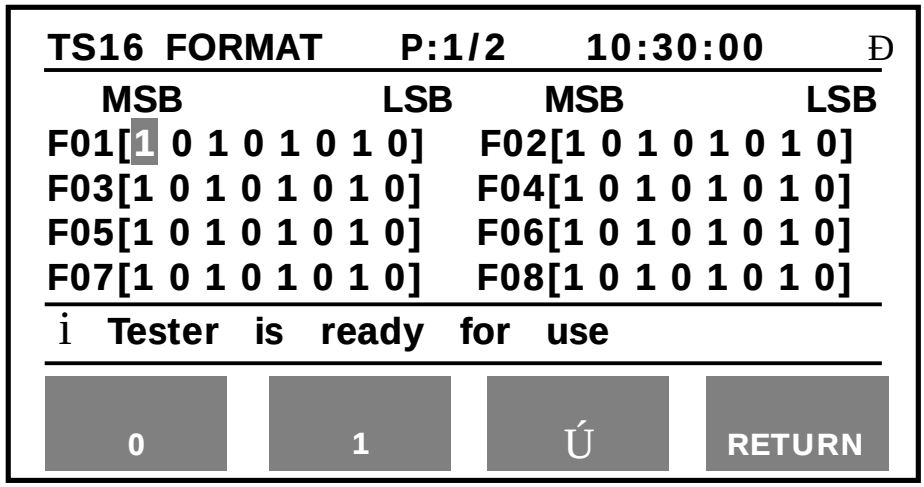

Fig 21: Page 1 of PCM31/CRC "TS16" timeslot settings

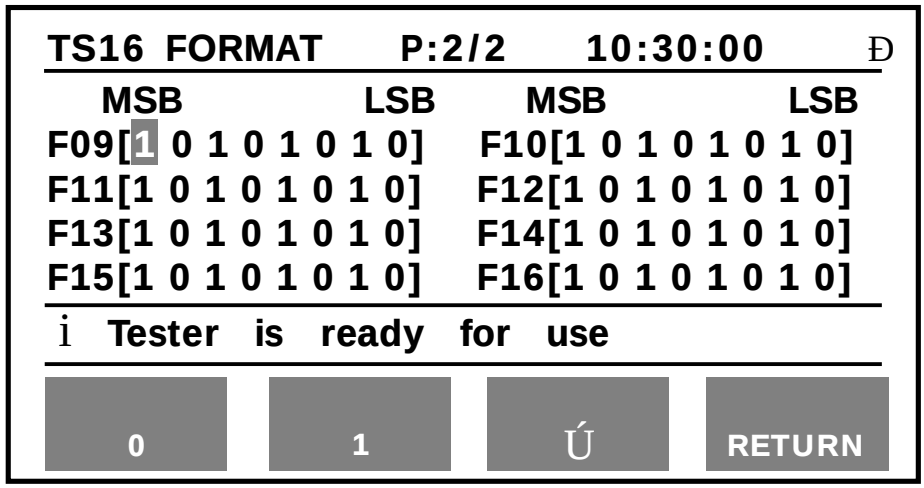

Fig 22: Page 2 of PCM31/CRC "TS16" timeslot settings

In E1 framed structure, idle word or audio signal can be inserted into some timeslots based on needs, with the menu as shown in Fig 23. The settings of "Signal injection" parameters are described in Table 15.

Option	Description
IDLE WORD	Insert 8-bit user-defined idle codes to one or more timeslots, as shown in Fig 14.
AUDIO	Insert VF tone signals with programmable frequency and level to one or more timeslots, frequency range: 200Hz～3400Hz with the step of 10Hz, level range: -60dBm～+3dBm.

Table 15: "Signal Injection" parameter settings

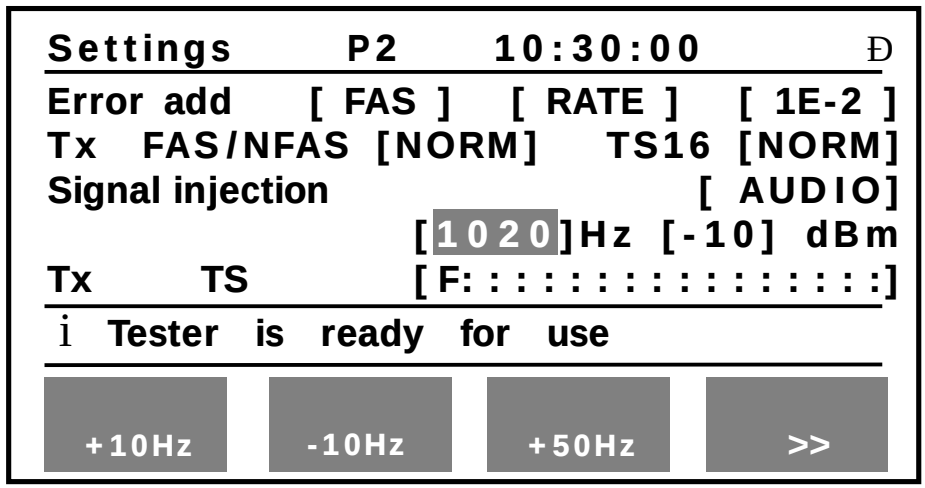
Settings P2 10:30:00
Error add [FAS] [RATE] [1E-2]
Tx FAS/NFAS [NORM] TS16 [NORM]
Signal injection [AUDIO]
[1020]Hz [-10] dBm
Tx TS [F: : : : : : : : : : : : : : : :]
Tester is ready for use
+10Hz
-10Hz
+50Hz
>>

Fig 23: "Audio" signal injection parameter settings menu

3.2.2 "Datacom" Settings Menu

3.2.2.1 Page 1 of "Datacom" Setting Menu

Return to the page 1 of "Settings" menu. Press the "F1" key in the "Function" item to select DATACOM. There have 4 pages in settings menu. Press the "Cursor Right and Down" key in

page 1 to the positions of "Interface", "Test mode", "BERT pattern" and "Polarity", and then select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys, as shown in Fig 24.

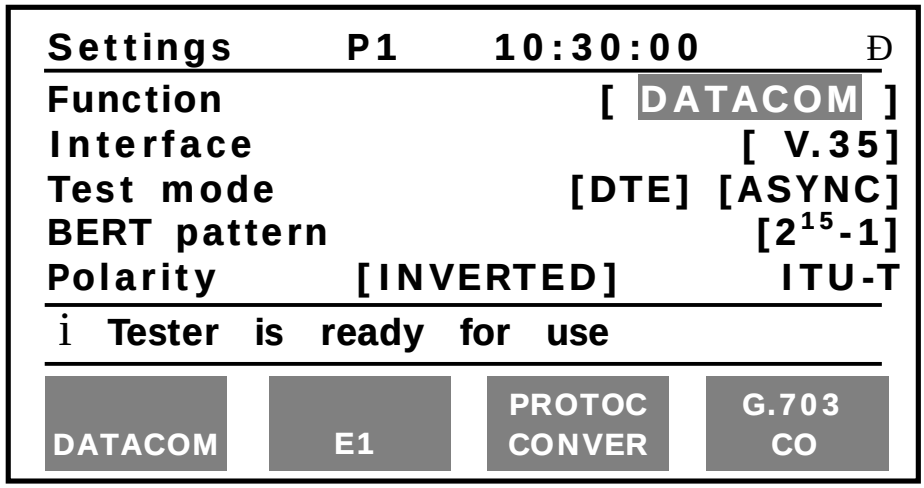

Fig 24: Page 1 of "Datacom" settings menu

The settings of datacom "Interface" parameters are as shown in Table 16.

Item	Option			
Interface	V.24	V.35	V.36	X.21
	RS-449	RS-485	EIA-530	EIA-530A

Table 16: Datacom "Interface" parameter settings

The settings of "Test mode" parameters are as shown in Table 17.

Item	Option			
Test mode	Emulation Mode		Data Framing	
	DTE	DCE	ASYNC	SYNC

Table 17: Datacom "Test mode" parameter settings

Note:

When DTE emulation mode is chosen, the datacom adapter cables provided with a DTE male connector should be used. When in DCE emulation mode, the cables provided with DCE female connectors should be used.

The settings of "Test pattern" parameters are as shown in Table 18.

Item	Option			Description
Test pattern	2^{20}-1		2^{15}-1	PRBS (Pseudorandom Binary Sequence)
	2^{11}-1	2^{9}-1	2^{6}-1	
	1111	0000	1010	Fixed code or static binary code can simulate AIS (1111) and etc.
	16BIT			16-BIT is a user defined word.

Table 18: Datacom "Test pattern" parameter settings

According to ITU-T recommendation, the test pattern of the datacom transmission system is somewhat different from the test pattern of E1 system. Please refer to Table 7 for comparison.

The settings of pattern "Polarity" parameters are as shown in Table 7.

3.2.2.2 Page 2 of Datacom Settings Menu in "ASYNC"

Displays shown in subsequent pages vary from the datacom test mode to the test mode. If the test mode in page 1 of the settings is chosen as ASYNC, press the "PgDn" key to enter into page 2 of datacom settings menu, then press the "Cursor Right and Down" key to move the cursor to positions to set "Character length", "Stop bits", "Parity" and "Tx data rate" parameters, and then select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys, as shown in Fig 25.

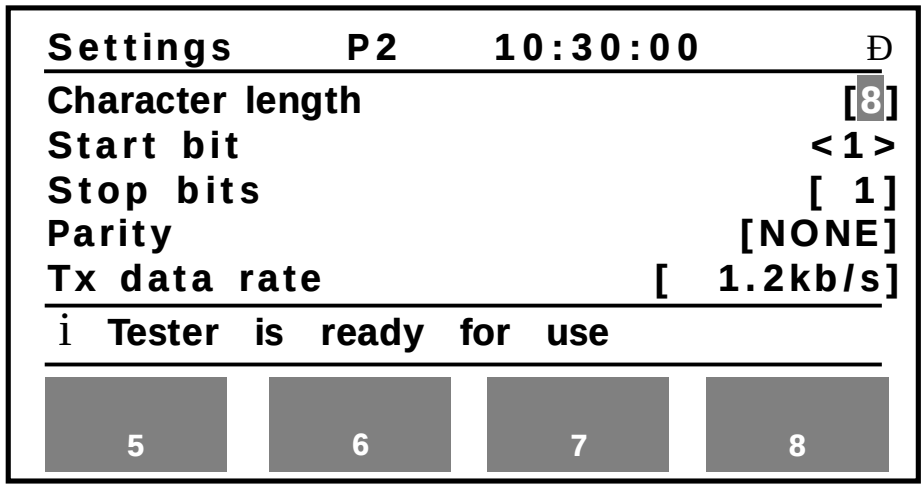

Fig 25: Page 2 of "Datacom" settings menu in "ASYNC"

The settings of "Character length", "Stop bits", "Parity" and "Tx data rate" parameters in ASYNC mode are as shown in Table 19.

Item	Option			
Character length	5	6	7	8
Start bit	Fixed as "1 bit "			
Stop bits	1	1.5	2	

Parity	ODD	EVEN	0	
	1	NONE		
Tx data rate	50b/s	75b/s	150b/s	300b/s
	600b/s	1.2kb/s	2.4kb/s	4.8kb/s
	9.6kb/s	19.2kb/s	38.4kb/s	57.6kb/s

Table 19: "Character length", "Stop bits", "Parity" and "Tx data rate" parameters

The setting of "Stop bits" is associated with "Character length", with their matching relations as shown in Table 20.

Character length	Stop bits settings
5, 6, 7, 8	1
5	1.5
6, 7, 8	2

Table 20: Relationship between "Stop bits" and "Character length"

3.2.2.3 Page 3 of "Datacom" Settings Menu

Press the "PgDn" key to enter into page 3 of the "Datacom" setting menu, as shown in Fig 25.

Before BER testing can proceed, it may nessary to establish a data path by using the instrument control circuit. In Fig 25, the statuses of data, clock and handshaking signals is displayed in real-time, with V.35 datacom interface as an example. Among which, the RS and DTR signal can be controlled as ON or OFF. There is no clock signal necessary for ASYNC mode, so all

clock signal statuses in figure are marked with "****". Circuit names will changed with different datacom interface chosen, please refer to the datacom interface pin-assignments in appendix B for the detailed circuit names of the data, clock and handshaking signals.

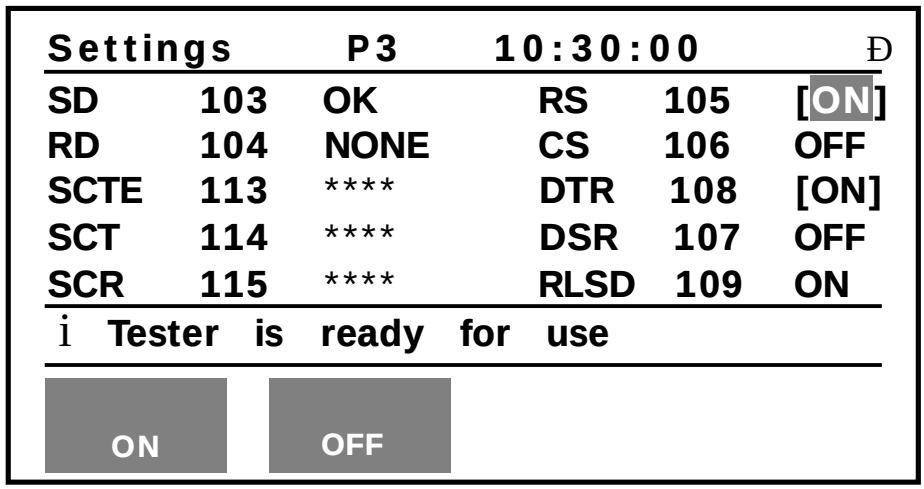
Settings P3 10:30:00 Đ
SD 103 OK RS 105 [ON]
RD 104 NONE CS 106 OFF
SCTE 113 **** DTR 108 [ON]
SCT 114 **** DSR 107 OFF
SCR 115 **** RLSD 109 ON
i Tester is ready for use
ON
OFF

Fig 25: Control circuits of a typical V.35 interface

3.2.2.4 Page 2 of Datacom Settings Menu in "SYNC"

When the test mode is chosen as SYNC, press the "PgDn" key to enter into page 2 of "Datacom" settings menu, and press the "Cursor Right and Down" key to move the cursor to positions to set "Tx clock source", "Rx clock source", "Tx output clock sense" and "Tx data rate" parameters, and then select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys, as shown in Fig 26.

Before making sttings of synchronous clock, the user must consider what transmit and receive clock configurations is to be used, details are given in the relavant parts of chapter 4 "Performing the Measurements".

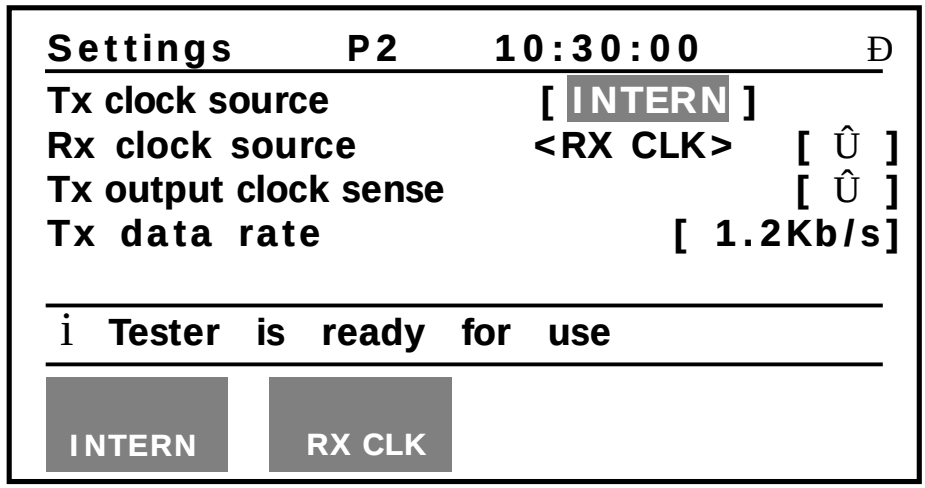
Settings P2 10:30:00 Đ
Tx clock source [INTERN]
Rx clock source <RX CLK> [Û]
Tx output clock sense [Û]
Tx data rate [1.2Kb/s]
i Tester is ready for use
INTERN
RX CLK

Fig 26: Page 2 of "Datacom" setting menu in "SYNC"

Note:

When the X.21 interface is selected:

The Tx and Rx clocks are fixed at INTERNAL when the instrument emulates a DCE or RX CLK when the instrument emulates a DTE.

l To Select the Transmit Clock Source

Move the cursor to "Tx clock source" to select the clock source that clocks data out of the instrument. Choose INTERNAL if you want the instrument to supply the clock, or RX CLK if you want the system under test to supply the clock. If INTERNAL is selected, then the "Tx data rate" setting will appear on the display. And the user can select a rate between 1200 b/s and 2.048M b/s (or up to 128 kb/s if the V.24 interface is selected). If the RX CLK is selected, then you can choose which edge of the incoming clock you want to clock data out on. Select Ÿ to clock on the rising edge, or to clock on the falling edge.

- **To Supply a Clock to the System Under Test**

  The instrument supplies a clock which can be used to clock data into the system under test. This clock is derived from the selected "Tx clock source". No clock is available from the instrument if the X.21 interface is selected when the instrument is emulating a DTE. Move the cursor to "Tx output clock sense" setting to select Ÿ and which makes the data clocked out coincident with the rising edge or falling edge.

- **To Select the Receive Clock Source**

  Move the cursor to "Rx clock source" to select the clock source that clocks data into the instrument. If the instrument is configured DTE, the "Rx clock source" is supplied from the INTERFACE only. If the instrument is configured as DCE, select INTERNAL if you want to use the clock supplied by the instrument to the system under test, or RX CLK if you want the system under test to supply the clock. For both DCE and DTE configurations when INTERNAL or RX CLK is selected, you can choose which clock edge you want to clock the data in on. Select Ÿ to clock on the rising edge, or to clock on the falling edge.

The settings parameters of the synchrnous clock are as shown in Table 21.

When making measurements in synchronization mode, the clock configurations are pretty complex. When the instrument

emulates a DTE or a DCE, the clock configurations should be properly set, otherwise some alarms such as "Pattern Loss", "Errors" and "Clock Loss" will be generated.

Item	Emulation	Option		
Tx clock source	DTE	INTERNAL	RX CLK	-
	DCE			¯
Rx clock source	DTE		RX CLK	-
				¯
	DCE	INTERNAL	RX CLK	-
				¯
Tx output clock sense				-
				¯

Table 21: Synchronous Clock Configurations

The settings of "Tx data rate" parameters are as shown in Table 22.

Item	Option			
Tx data rate	64kb/s or below	1.2kb/s	2.4kb/s	4.8kb/s
		9.6kb/s	19.2kb/s	38.4kb/s
	N×64kb/s	+1	-1	
		+10	-10	

Table 22: "Tx data rate" configurations

3.2.2.5 Page 3 of Datacom Settings Menu in "SYNC"

Press the "PgDn" key to enter into page 3 of "Datacom" settings menu. The instrument also detects the clock, data and handshaking signals in SYNC mode, as shown in Fig 27. An

effective clock is needed under synchronization mode. It is very easy for the user to observe the statuses of these signals to troubleshoot the problems when making the synchrounous measurements.

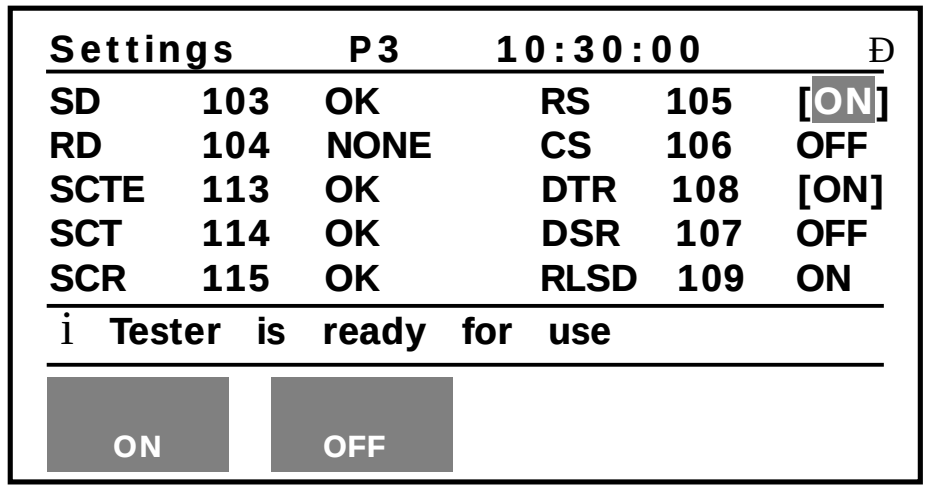
Settings P3 10:30:00
SD 103 OK RS 105 [ON]
RD 104 NONE CS 106 OFF
SCTE 113 OK DTR 108 [ON]
SCT 114 OK DSR 107 OFF
SCR 115 OK RLSD 109 ON
Tester is ready for use
ON
OFF

Fig 27: Control circuits of V.35 in "SYNC"

The control circuits of "RS" and "DTR" can be set ON or OFF in the displays.

3.2.2.6 Page 4 of Datacom Settings Menu

Press the "PgDn" key to enter into page 4 of the "Datacom" settings menu, press the "Cursor Right and Down" key to move the cursor to positions to set "Error add", "Resolution", "Storage" and "Duration" parameters, and then select relevant parameters by pressing "F1", "F2", "F3", "F4" keys, as shown in Fig 28.

"Error add", "Resolution", "Storage" and "Duration" setting parameters are same with those in "E1" testing. All the descriptions of these parameters are described in Table 9b, Table 10 respectively.

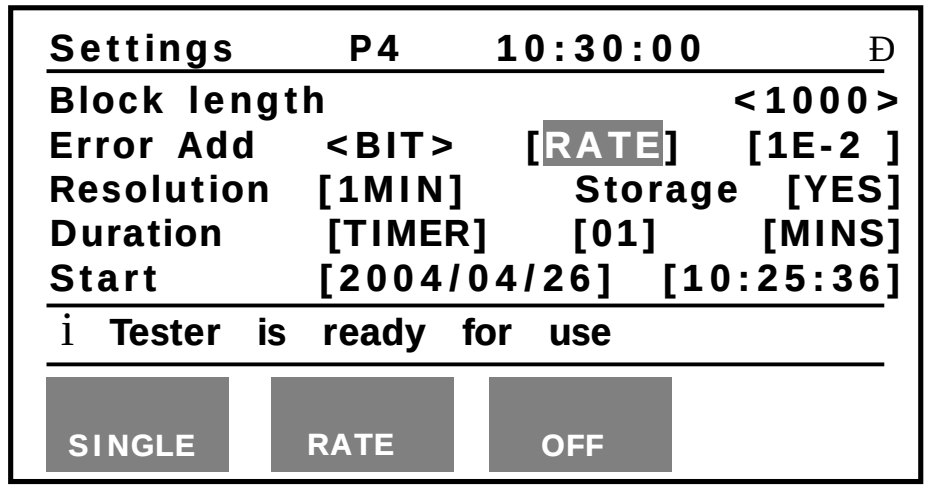

Fig 28: Page 4 of "Datacom" settings menu

3.2.3 "G.703 CO" Settings Menu

Return to the "Settings" main menu, move the cursor to the "Function" item and press the "F4" key to select G.703 CO settings menu, as shown in Fig 29.

The G.703 CO testing is provided as an optional function of the E1/Datacom tester. When the G.703 CO firmware module is mounted inside the instrument, the instrument will automatically recognize it and display its option in the "Function" item.

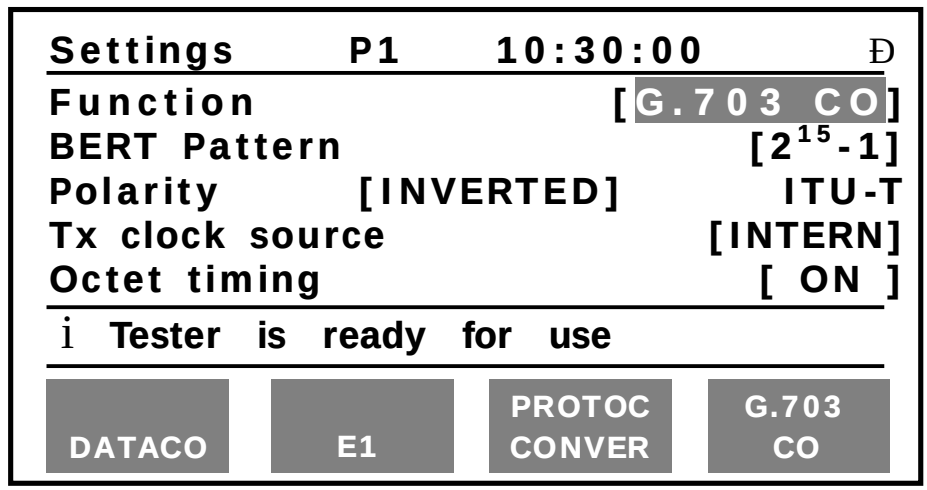

Fig 29: Page 1 of "G.703 CO" settings menu

3.2.3.1 Page 1 of "G.703 CO" Settings Menu

The "G.703 CO" settings menu consists of 2 pages, with the page 1 as shown in Fig 29. Relevant parameters can be chosen by pressing the "Cursor Right and Down" key to move the cursor to positions to set "BERT pattern", "Polarity", "Tx clock source" and "OCTET Timing" parameters by pressing "F1", "F2", "F3", "F4" softkeys.

"BERT pattern", "Polarity", and "Tx clock source" setting parameters are same with those in "E1" testing. All the descriptions of these parameters are described in Table 7, Table 8 respectively.

The settings of "OCTET Timing" parameter are as shown in Fig 23.

Item	Option	Description
OCTET Timing	ON	When making measurements with the G.703 CO interface, be sure to set the OCTET Timing in ON status, so as to recover circuit clock accurately.
	OFF	In self-loop test, the OCTET Timing can be set in OFF status.

Fig 23: "OCTET Timing" parameter settings

3.2.3.2 Page 2 of "G.703 CO" Settings Menu

Press the "PgDn" key to enter into page 2 of the "G.703 CO" settings menu, press the "Cursor Right and Down" key to move the cursor to positions to set "Error add", "Resolution",

"Storage" and "Duration" parameters, and then select relevant parameters by pressing "F1", "F2", "F3", "F4" keys, as shown in Fig 30.

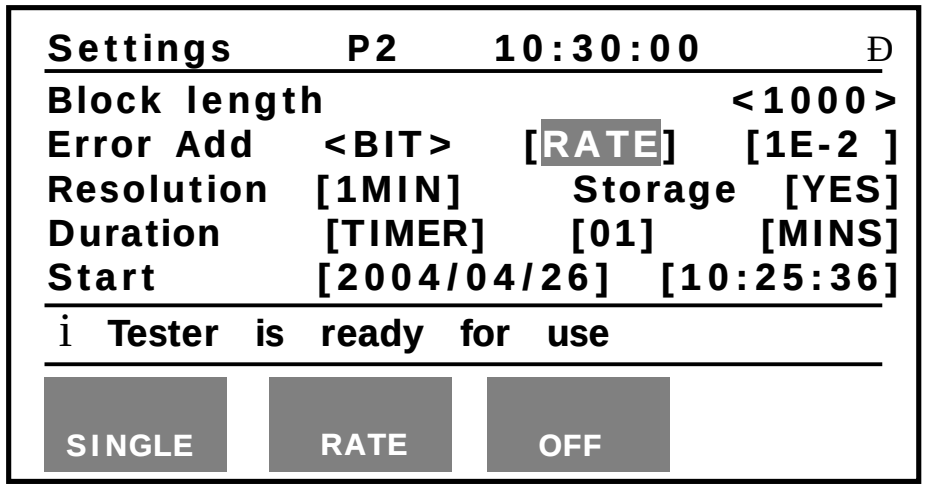

Fig 30: Page 2 of "G.703 CO" settings menu

"Error add", "Resolution", "Storage" and "Duration" setting parameters are same with those in "E1" testing. All the descriptions of these parameters are described in Table 9b, Table 10 respectively.

3.2.4 "PROTOCOL CONVERTER" Settings Menu

"Protocol Converter" testing function always named with "Mux/Demux" in other instruments, is used to make BER testing for multiplexing or de-multiplexing. This function can give the evaluation of Mux and Demux performance of the system under test. Since the protocol converters such as V.35-E1, V.24-E1 converters are commonly and largely used in China, E1/Datacom tester provides this function for the synchronous BER testing of different datacom interfaces with the E1 interface.

3.2.4.1 Page 1 of "Protocol Converter" Settings

Return to the "Settings" main menu, move the cursor to the "Function" item and press the "F4" key to select PROTOCOL CONVERTER settings menu, as shown in Fig 31.

The "Protocol Converter" settings menu consists of 5 pages, in page 1, press the "Cursor Right and Down" key to move the cursor to positions to set "Tx interface", "Rx interface", "Framing", "BERT pattern" and "Polarity" parameters, and select relevant parameters by pressing "F1", "F2", "F3", "F4" softkeys, as shown in Fig 31.

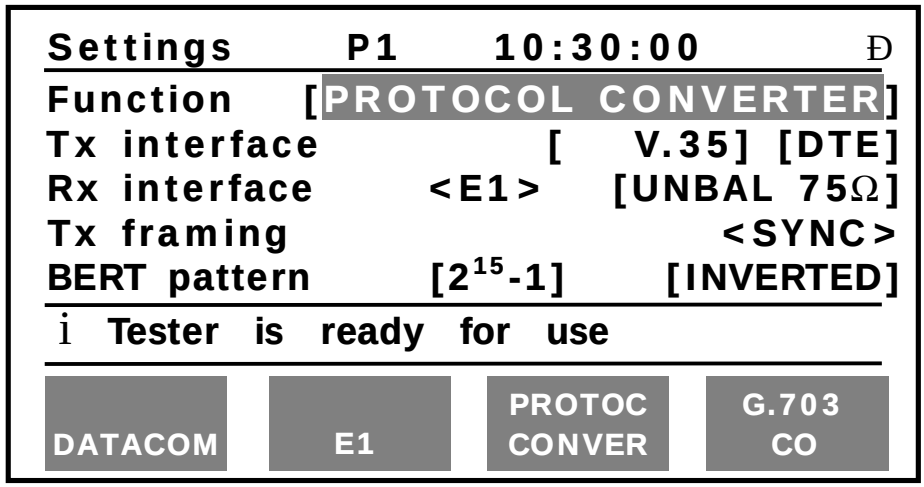

Fig 31: Page 1 of "Protocol Converter" settings menu

The settings of relevant "Tx interface" and "Rx interface" parameters are as shown in Table 24.

Under the test mode of relevant protocol converters, the matching relation of Tx and Rx interface types is as shown in Table 25.

Item	Option			
Tx/Rx interface	V.24	V.35	V.36	X.21
	RS-449	RS-485	EIA-530	EIA-530A
	E1			
	G.703 CO			

Table 24: "Tx/Rx interface" parameter settings

Tx Interface	Rx Interface
E1	V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A
	G.703 CO
V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A	E1
G.703 CO	E1

Table 25: Matching relation of "Tx" and "Rx" interface

The test data bandwidth is determined by the Tx interface settings, as shown in Table 26.

Tx Interface	Rx Interface	
E1	UNFRAMED	32*64k
	PCM30	N*64k (N=1～30)
	PCM30CRC	N*64k (N=1～30)
	PCM31	N*64k (N=1～31)
	PCM31CRC	N*64k (N=1～31)

V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A	N*64k (N=1～32)
V.24	N*64k (N=1～2)
G.703 CO	64k

Table 26: Tx data bandwidth descriptions

The bandwidth of the Tx data set must equal to that of the Rx data, otherwise no test will be allowed to start.

For the settings of other parameters in page 1, please refer to the descriptions of the relevant interfaces.

3.2.4.2 Page 2 of "Protocol Converter" Settings

- **When the "Tx interface" is chosen as E1, refer to the settings menu of E1.**
- **When the "Tx interface" is chosen as V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530 or EIA-530A, refer to the settings menu of DATACOM.**
- **When the "TX interface" is chosen as G.703 CO, refer to the settings menu of G.703 CO.**

3.2.4.3 Page 3 of "Protocol Converter" Settings

- **When the "Rx interface" is chosen as E1, refer to the settings menu of E1.**
- **When the "Rx interface" is chosen as V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530 or EIA-530A, refer to**

the settings menu of DATACOM.

- When the "RX interface" is chosen as G.703 CO, refer to the settings menu of G.703 CO.

3.2.4.4 Page 4 of "Protocol Converter" Settings

- When the "Tx interface" or the "Rx interface" is chosen as V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530 or EIA-530A, the displays of the data, clock and handshaking signals appear on this page. And the user can set up the control circuits.

- When the "Tx interface" or the "Rx interface" is chosen as G.703 CO, see the page 5.

3.2.4.5 Page 5 of "Protocol Converter" Settings

In the page 5, press the "Cursor Right and Down" key to move the cursor to positions to set "Error add", "Resolution", "Storage" and "Duration" parameters, and then select relevant parameters by pressing "F1", "F2", "F3", "F4" keys, as shown in Fig 32.

"Error add", "Resolution", "Storage" and "Duration" setting parameters are same with those in "E1" testing. All the descriptions of these parameters are described in Table 9b, Table 10 respectively.

The parameter settings of clock configurations in "Protocol Converter" mode are as shown in Table 27a, Table 27b.

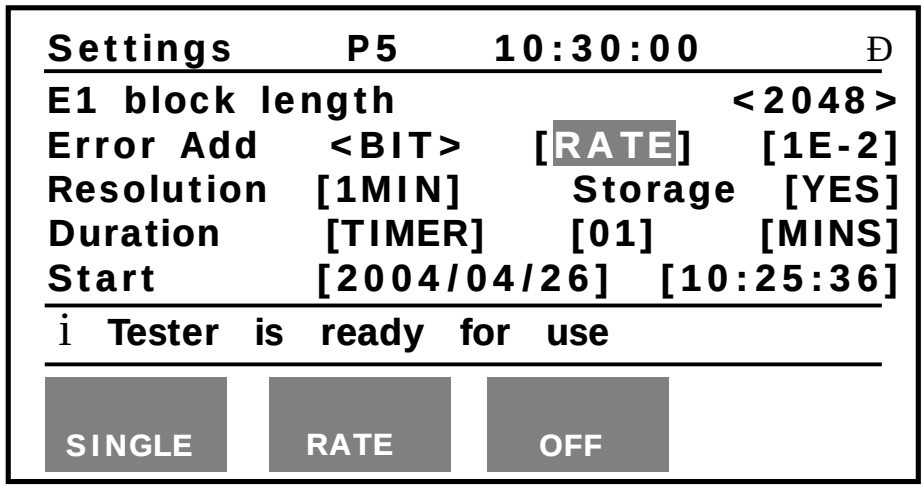

Fig 32: Page 5 of "Protocol Converter" settings menu

Tx interface	TX clock source
E1	Fixed at INTERNAL No frequency deviation
V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A	Fixed at INTERNAL Clock sense: - or ¯
G.703 CO	Fixed at INTERNAL

Table 27a: Tx Clock configurations in "Protocol Converter"

Rx interface	RX clock source parameter description	
E1	Fixed at RX CLK	
V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A	DTE	Fixed at RX CLK Clock sense: - or ¯
	DCE	INTERNAL or RX CLK Clock sense: - or ¯
G.703 CO	Fixed at RX CLK	

Table 27b: Rx Clock configurations in "Protocol Converter"

3.3 "Results" Menu

After setting up the measurement parameters, user can start a test with the instrument by pressing the "Start/Stop" key. When performing the measurements, the "Start/Stop" LED indicator turns on, then press the "Result" key to display all the results. The "Results" menu has different displays under various test modes. And we will describe them respectively according to different test settings.

3.3.1 "E1" Results Menu

3.3.1.1 "Results" Menus in E1 "TX/RX" Mode

Results / Framing	Basic Analysis	G.821 Analysis	G.826 Analysis	M.2100 Analysis	Alarm Seconds	Signal Analysis	Event Records	Timeslot Analysis
Unframed	·	·	·		·	·	·	
PCM30	·	·		·	·	·	·	·
PCM30CRC	·	·		·	·	·	·	·
PCM31	·	·		·	·	·	·	·
PCM31CRC	·	·		·	·	·	·	·

Table 28: Effects of framings on results in E1 "TX/RX" mode

The "Results" menus in the E1 "TX/RX" mode provide full measurement analysis including "Basic Analysis", "G.821 Analysis", "G.826 Analysis", "M.2100 Analysis", "Alarm Seconds", "Signal Analysis", "Event Records" and so on. Press "F1", "F2", "F3" and "F4" softkeys to select the analysis displays accordingly in the menu.

As the different framing has been chosen, the results displays in E1 "TX/RX" mode are different, refer to the effects of framings on results as shown in Table 28.

a. Basic Analysis

"Basic Analysis" performs result statistics of error count, error free seconds, current error ratio, average error ratio for BIT, FAS, CODE, CRC4 and E-BIT errors and errored block count and background errored blocks (only appears when unframed testing is chosen) for BIT errors.

"Basic Analysis" result menu is as shown in Fig 33. The relevant result analysis items are described in Table 29. And the effects of framings on "Basic Analysis" are as shown in Table 30.

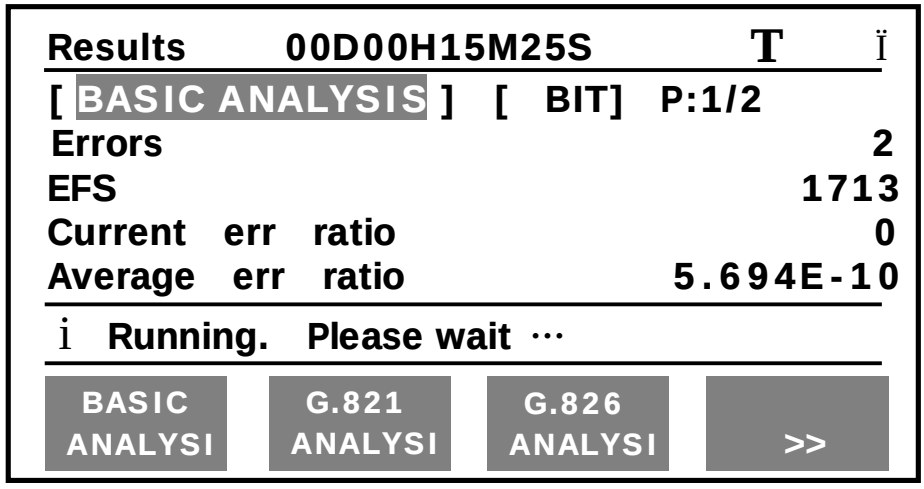

Fig 33: "Basic Analysis" result menu

The effects of alarms on error counts in "Basic Analysis" are as shown in Table 31, Table 32.

Result Analysis	Item	Description
Basic Analysis	Errors	Errors are counted for all sources over total elapsed time. Counting may be inhibited under certain alarm conditions, see Effects of Alarms on Basic Errors below.
	EFS (%EFS)	Error Free Seconds are counted for all sources over total elapsed time. Counting may be inhibited under certain alarm conditions, see Effects of Alarms on Basic Errors below. % Error Free Seconds is the number of error free seconds during a test period expressed as a percentage of the elapsed seconds.
	Current err ratio	Current Error Ratio is the error ratio measured over the last second.
	Average err ratio	Average Error Ratio is the error ratio measured over total elapsed time.
	EB	Errored Blocks are counted for the BIT source over total elapsed time.
	BBE	Background Errored Blocks are counted for BIT source over total elapsed time.

Error Sources	BIT	Received bit violations in BERT pattern set in the instrument.
	FAS	Word errors in the FAS in timeslot 0.
	CODE	Bipolar violations in AMI code or code violations in HDB3 code.Bipolar violations are defined as consecutive marks of the same polarity. Code violations are defined as consecutive bipolar violations of the same polarity.
	CRC4	Received CRC4 errors in CRC4 Multi-frames.
	E-BIT	Far-end Block Errors (FEBE) reported in the first bit of frames 13 and 15 on E1 lines running with CRC4 multiframe.

Table 29: "Basic Analysis" in E1 "TX/RX" mode

Effected Item	Un-framed	PCM30	PCM30 CRC	PCM31	PCM31 CRC
BIT Error	·	·	·	·	·
EFS	·	·	·	·	·
Current error rate	·	·	·	·	·
Average error rate	·	·	·	·	·
EB	·				

BBE	·				
FAS error		·	·	·	·
Code error	·	·	·	·	·
CRC4 error			·		·
E-BIT error			·		·

Table 30: Effects of framings on "Basic Analysis"

Note

The instrument will disable "*" the counting of errors in the presence of various alarms which are in context for the current settings of the instrument. These alarms will affect the error count (EC) and the error free seconds (EFS) results.

EC/EFS EB/BBE	Signal Loss	AIS	Pattern Loss
BIT	*	*	*
CODE	*	*	*

Table 31: Effects of alarms on error counts in the unframed E1

EC /EFS	Signal Loss	AIS	Frame Loss	CAS Frame Loss	CRC Frame Loss	Pattern Loss
BIT	*	*	*			*
CODE	*					
FAS	*	*	*	*	*	
CRC4	*	*	*		*	
E-BIT	*	*	*		*	

Table 32: Effects of alarms on error counts in the framed E1

b. G.821 Analysis

"G.821 Analysis" performs result statistics of errored seconds (ES and %ES), severely errored seconds (SES and % SES), degraded minutes (DM and %DM), unavailable time (UAS and %UAS) for BIT errors. The displays of unframed and framed E1 testing in "G.821 Analysis" are same, as shown in Fig 34.

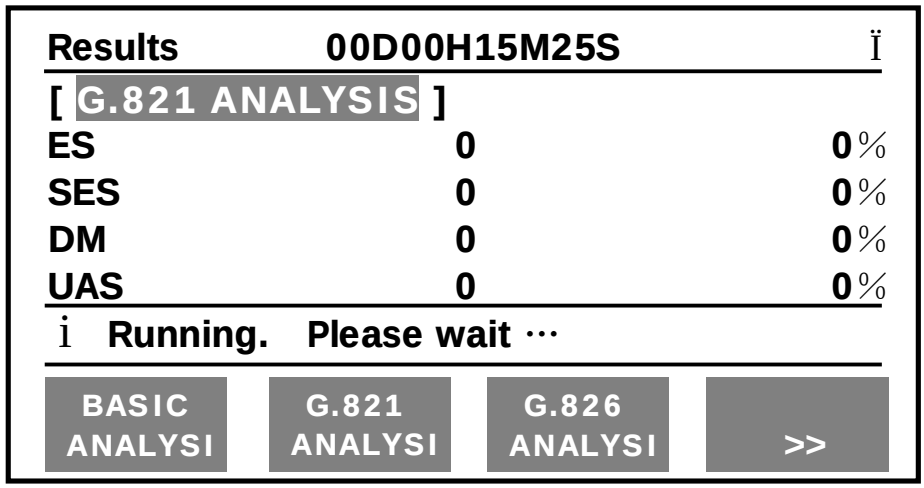

Fig 34: "G.821 Analysis" result menu

The relevant result analysis items are described in Table 33.

Item	Description
ES	Asynchronous errored seconds (ES) are counted over the available time.
%ES	Asynchronous errored seconds counted over the available time expressed as a percentage of the available time in seconds.
SES	The number of severely errors seconds (SES) is counted over the available time. A severely-errored

	second is a second which has an error ratio worse than the threshold 10^{-3}.
%SES	The number of severely errored seconds (SES) expressed as a percentage of the available time in seconds.
DM	The number of degraded minutes (DM) during the test period. A degraded minute is a 60 second (1 minute) composite interval during the available time (excluding severely errored seconds) over which the error ratio is worse than 10^{-6}.
%DM	The number of degraded minutes expressed as a percentage of the total number of elapsed minutes of available time.
UAS	Unavailable Seconds (UAS) is the number of unavailable seconds during a test period. A system becomes "available" when the error ratio measured in 1 second intervals is better than the severely errored second threshold for 10 or more consecutive seconds. A system becomes "unavailable" when the error ratio measured in 1 second intervals is greater than the severely errored second threshold for 10 or more consecutive seconds.
%UAS	The number of unavailable seconds during a test period expressed as a percentage of the total number of elapsed seconds.

Table 33: "G.821 Analysis" in E1 "TX/RX" mode

The effects of alarms on error counts in "G.821 Analysis" are as shown in Table 34, Table 35.

	Signal Loss	AIS	Pattern Loss
ES / SES	*	*	*

Table 34: Effects of alarms on ES/SES in the unframed E1

	Signal Loss	AIS	Frame Loss	CAS Frame Loss	CRC Frame Loss	Pattern Loss
ES / SES	*	*	*			*

Table 35: Effects of alarms on ES/SES in the framed E1

c. G.826 Analysis

"G.826 Analysis" performs result statistics of errored block seconds (EBS and %EBS), severely errored block seconds (SEBS and % SEBS), background blocks errors (BBE and %BBE), unavailable time (UAS and %UAS) for BIT errors. Since "G.826 Analysis" counts the errors based on continuous serial data blocks, so "G.826 Analysis" is not provided in E1 framed testing, as shown in Fig 35.

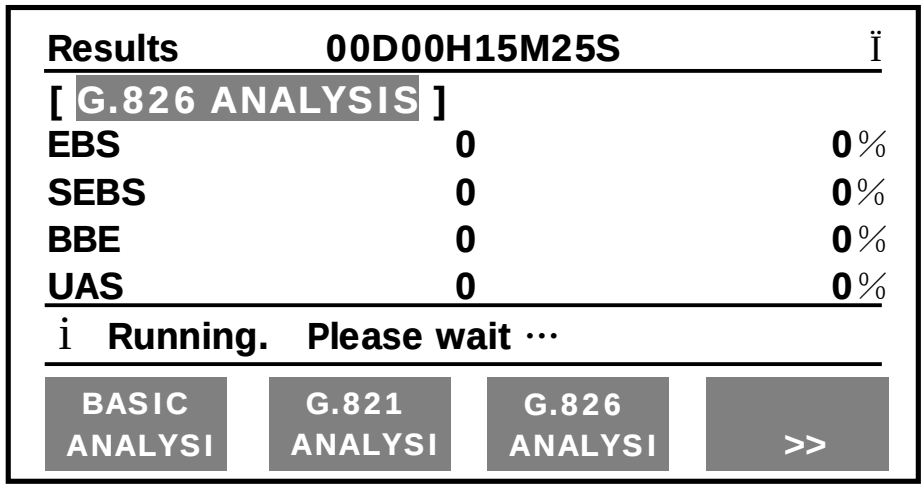

Fig 35: "G.826 Analysis" result menu

The relevant result analysis items are described in Table 36.

Item	Description
EBS	Errored Block Seconds (EBS) are counted for all sources over total elapsed time.
%EBS	The number of errored block seconds counted over the available time expressed as a percentage of total elapsed time of a test period in seconds.
SEBS	The number of severely errored block seconds (SEBS) is counted over the available time. A severely-errored block second is a second which has an errored block ratio worse than 30%.
%SEBS	The number of severely errored block seconds (SEBS) expressed as a percentage of the available time in seconds during the total elapsed time.
BBE	Background Block Errors are counted for the errored blocks not occurring as a part of an SES.
%BBE	The ratio of errored blocks to total blocks during a fixed measurement interval, excluding all blocks during SES and unavailable time.
UAS	The number of unavailable seconds during a test period. A system becomes "available" when the errored block ratio measured in 1 second intervals is better than the severely errored block second threshold for 10 or more consecutive seconds. A system becomes "unavailable" when the errored block ratio measured in 1 second intervals is greater

	than the severely errored block second threshold for 10 or more consecutive seconds.
%UAS	The number of unavailable seconds during a test period expressed as a percentage of the total number of elapsed seconds.

Table 36: "G.826 Analysis" in E1 "TX/RX" mode

The effects of alarms on the block counts in "G.826 Analysis" are as shown in Table 37.

	Signal Loss	AIS	Pattern Loss
EBS/SEBS	*	*	*

Table 37: Effects of alarms on EBS/SEBS in the unframed E1

d. M.2100 Analysis

ITU-T M.2100 recommendation is used to evaluate the connection quality of E1 line in a long-term test. "M.2100 Analysis" provides statistics counts of errored seconds (ES), severely errored seconds (SES) and unavailable time (UAS) in both transmit (Tx) and receive (Rx) directions for in-service and out-of-service testing. Since it counts errors based on frame data, "M.2100 Analysis" is only provided in the E1 framed testing, as shown in Fig 36.

The relevant result analysis items are described in Table 38.

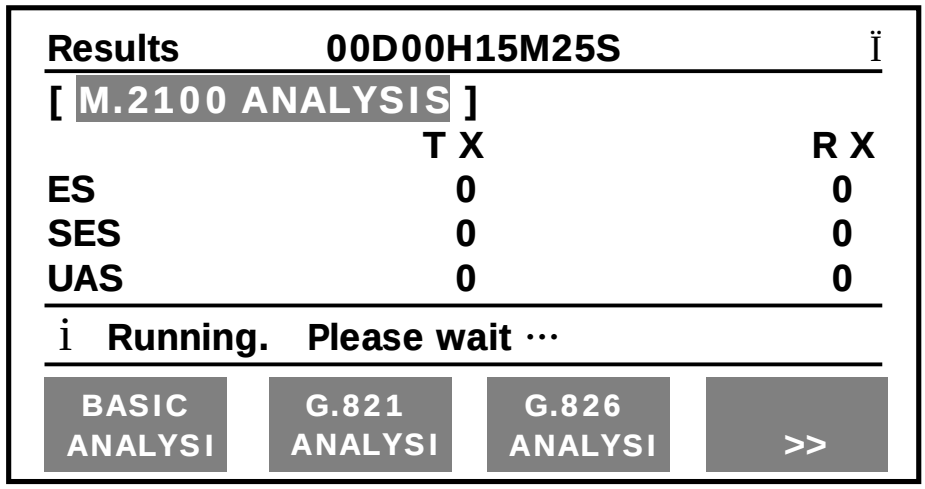

Fig 36: "M.2100 Analysis" result menu

Item		Description	
Rx Direction	ES	Non-CRC4 Framing	A second containing 1 or more errors from 1 or more sources: ≥ 1 Signal loss, ≥ 1 Frame loss, ≥ 1 AIS, ≥ 1 errored FAS, ≥ 28 frame bit errors.
		CRC4 Framing	A second containing 1 or more errors from 1 or more sources: ≥ 1 Signal loss, ≥ 1 Frame loss, ≥ 1 AIS, ≥ 1 CRC4 errors, ≥ 805 CRC4 errors.
	SES	Non-CRC4 Framing	A second containing 1 or more errors from 1 or more sources: ≥ 1 Signal loss, ≥ 1 Frame loss, ≥ 1 AIS, ≥ 28 frame bit errors.
		CRC4 Framing	A second containing 1 or more errors from 1 or more sources: ≥

			1 Signal loss, ≥ 1 Frame loss, ≥ 1 AIS, ≥ 805 CRC4 errors.
	UAS	Same with "UAS" descriptions in Table 33.	
Tx Direction	ES	Non-CRC4 Framing	A second containing 1 or more errors from RDI source: ≥ 1 Remote alarm.
		CRC4 Framing	A second containing 1 or more errors from 1 or more sources: ≥ 1 Remote alarm, ≥ 1 E-BIT errors.
	SES	Non-CRC4 Framing	A second containing 1 or more errors from 1 or more sources: ≥ 1 Remote alarm.
		CRC4 Framing	A second containing 1 or more errors from 1 or more sources: ≥ 1 Remote alarm, ≥ 805 E-BIT errors.
	UAS	Same with "UAS" descriptions in Table 33.	

Table 38: "M.2100 Analysis" in E1 "TX/RX" mode

e. Alarm Seconds

"Alarm Seconds" give the error counts in seconds of loss of signal, AIS, loss of frame, loss of pattern, clock slip, remote alarm, loss of CRC4 multiframe, loss of CAS multiframe and so on. "Alarm Seconds" result menu is as shown in Fig 37, and the relevant result analysis items are described in Table 39.

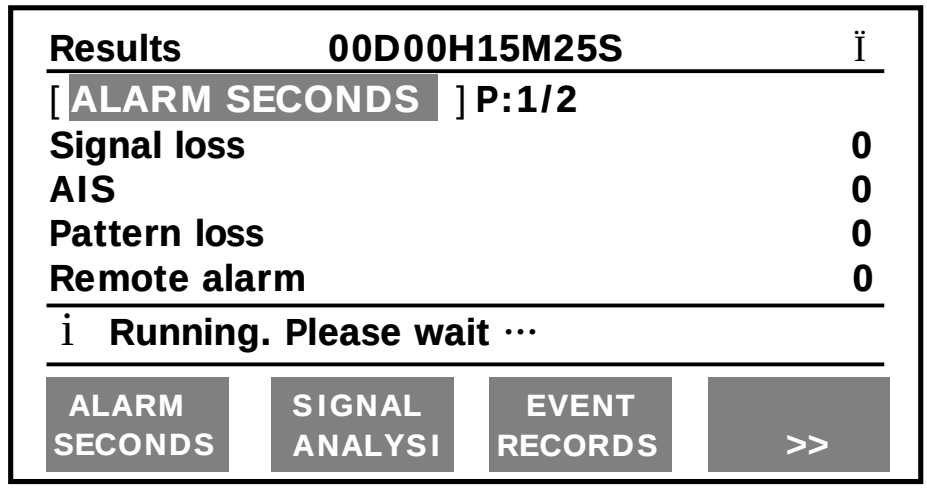

Fig 37: "Alarm Seconds" result menu

The effects of framings on alarm seconds counts in "Alarm Seconds" are as shown in Table 39.

Item	Description
Signal loss	The number of seconds during which signal loss was detected, counted over the elapsed test period.
AIS	The number of seconds during which AIS was detected, counted over the elapsed test period.
Pattern loss	The number of seconds during which pattern loss was detected, counted over the elapsed test period.
Clock slip	The number of seconds during which clock slips were detected, counted over the elapsed test period. Only provided in PRBS test patterns.

Remote alarm	The number of seconds during which remote alarm was detected, counted over the elapsed test period.
Remote MF alarm	The number of seconds during which remote multiframe alarm was detected, counted over the elapsed test period.
Frame loss	The number of seconds during which frame loss was detected, counted over the elapsed test period.
CAS MF loss	The number of seconds during which CAS multiframe loss was detected, counted over the elapsed test period.
CRC MF loss	The number of seconds during which CRC multiframe loss was detected, counted over the elapsed test period.

Table 39: "Alarm Seconds" in E1 "TX/RX" mode

Seconds Counted	Un-framed	PCM30	PCM30 CRC	PCM31	PCM31 CRC
Signal Loss	·	·	·	·	·
AIS	·	·	·	·	·
Pattern Loss	·	·	·	·	·
Clock Slip	·				
Remote Alarm		·	·	·	·
Remote MF Alarm		·	·		

Frame loss		·	·	·	·
CAS MF loss		·	·		
CRC MF loss			·		·

Table 40: Effects of framings on alarm seconds counts

f. Signal Analysis

"Signal Analysis" provides the real-time signal measurement of received signals, including Rx line rate, frequency offset and signal level, as shown in Fig 38. The displays of "Signal Analysis" in E1 unframed and framed testing is same.

The relevant result analysis items are described in Table 41.

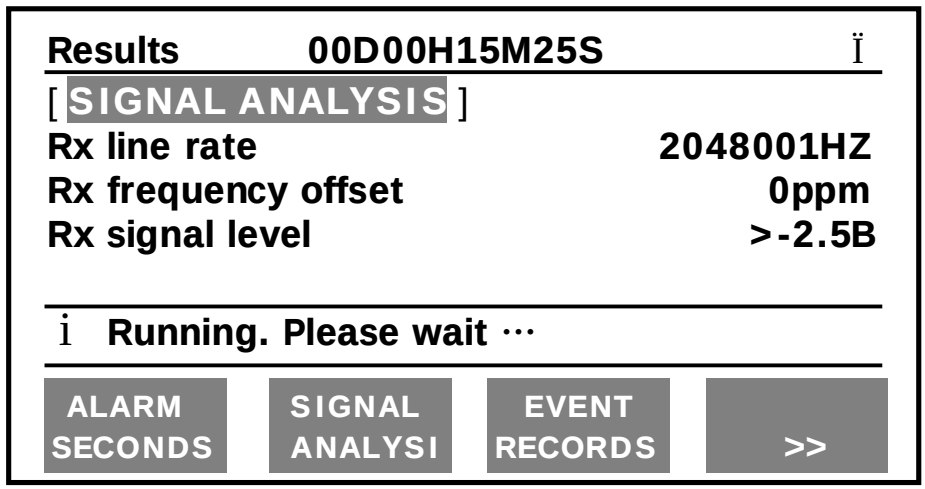

Fig 38: "Signal Analysis" result menu

Item	Description
Line Rate	The frequency of received 2 Mb/s signal relative to the internal reference clock.
Frequency Offset	Frequency offset calculation relative to the internal reference clock. The offset need to

	comply with the limits specified in ITU-T G.703 ≤ ±50ppm.
Signal Level	The level is measured of received 2 Mb/s signal in the range -2.5dB～-43dB with the step of 2.5dB

Table 41: "Signal Analysis" in E1 "TX/RX" mode

g. Event Records

During the test, if an error or an alarm occurs in the setting resolution time, then one event will be generated by the instrument accordingly. And the event records number is added by 1 every the resolution time. The event records sum will be updated in accumulation with the storage interval (for example, 1 minute, 15 minutes, 1 hour), as shown in Fig 39. Event records can be further uploaded via one test result by TestManager software. And in TestManager, user can see when the alarms and errors happened in histogram analysis.

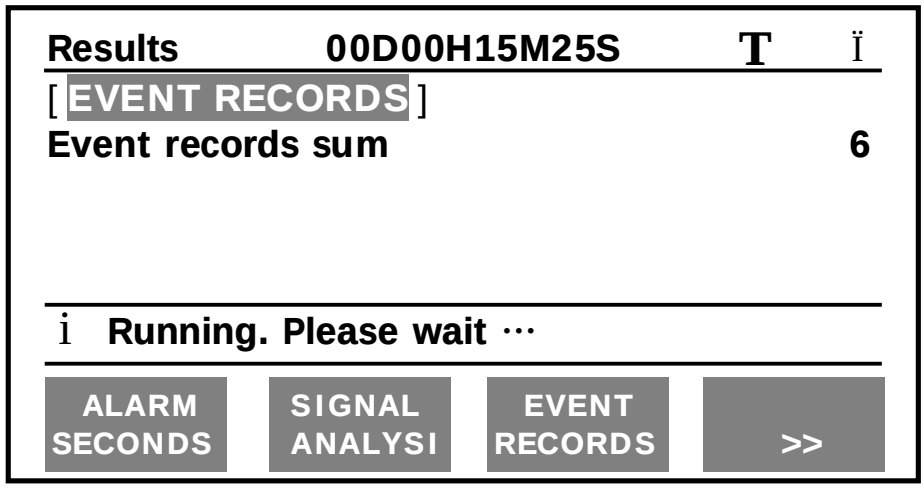

Fig 39: "Event Records" result menu

h. TS Analysis

"TS Analysis" provides the timeslot analysis under E1 framed

testing. The specific contents of "TS Analysis" are shown in the displays under E1 "RX HI-Z" mode below, refer to 3.3.1.2 for details.

3.3.1.2 "Results" Menu in E1 "RX HI-Z" Mode

"RX HI-Z" mode is normally used in out-of-service measurement of E1 line. The "Results" menus under E1 "RX HI-Z" mode provide full measurement analysis including "Errors Count", "M.2100 Analysis", "Alarm Seconds", "Signal Analysis", "Event Records", "TS Analysis" and so on. Press "F1", "F2", "F3", "F4" softkeys to select the analysis displays accordingly in the menu.

As the different framing has been chosen, the results displays in E1 "RX HI-Z" mode are different, refer to the effects of framings on results as shown in Table 42.

	Un-framed	PCM30	PCM30CRC	PCM31	PCM31CRC
Errors Count	.	.	.	.	.
M.2100 Analysis		.	.	.	.
Alarm Seconds	.	.	.	.	.
Signal Analysis	.	.	.	.	.
Event Records	.	.	.	.	.
TS Analysis		.	.	.	.

Table 42: Effects of framings on results in E1 "RX HI-Z" mode

a. Errors Count

"Errors count" provides the full errors statistics for CODE, FAS, CRC4 and E-BIT, as shown in Fig 40. The relevant descriptions are shown in Table 43. The effects of framing on errors count are shown in Table 43.

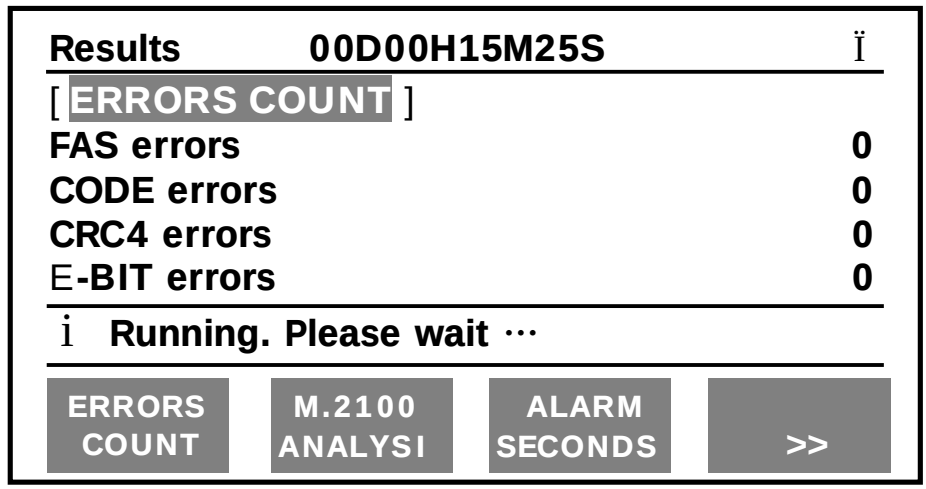

Fig 40: "Errors Count" result menu in E1 "RX HI-Z" mode

Errors Counted	Unframed	PCM30	PCM30CRC	PCM31	PCM31CRC	Counter is Disabled by
CODE	·	·	·	·	·	Loss of signal
FAS		·	·	·	·	The framer is searching for FAS alignment and/or synchronization at either the CAS or CRC4 multiframe level.
CRC4			·		·	Loss of frame synchronization at either the FAS or CRC4 level.

E-BIT			·		·	Loss of frame synchronization at either the FAS or CRC4 level.

Table 43: Effects of framings on "Errors Count"

b. M.2100 Analysis

"M.2100 Analysis" menu is as shown in Fig 36. And the relevant analysis results are described in Table 38. "M.2100 Analysis" is not provided in unframed testing.

c. Alarm Seconds

"Alarm Seconds" menu is as shown in Fig 37. And the relevant analysis results are described in Table 39.

The effects of framings on "Alarm Seconds" are as shown in Table 40.

d. Signal Analysis

"Signal Analysis" menu is as shown in Fig 38. And the relevant analysis results are described in Table 41.

e. Event Records

"Event Records" result menu is as shown in Fig 39.

f. TS Analysis

"TS Analysis" provides timeslot analysis of framed E1 signal. The full frame data can be monitored in this analysis including frame alignment (FAS and NFAS), timeslot 16 data, speech timeslot data and timeslot activities, as shown in Fig 41.

Since the timeslot 16 is used to transmit multiframe alignment

signal and CAS signaling data in PCM30/CRC framing and common 64 kb/s data or CCS messages in PCM31/CRC framing, the results of it will be displayed different on framing configured in the settings menu. The effects of framings on analysis items are shown in Table 44. FAS and NFAS displays also are affected by CRC4 framing or non-CRC4 framing chosen.

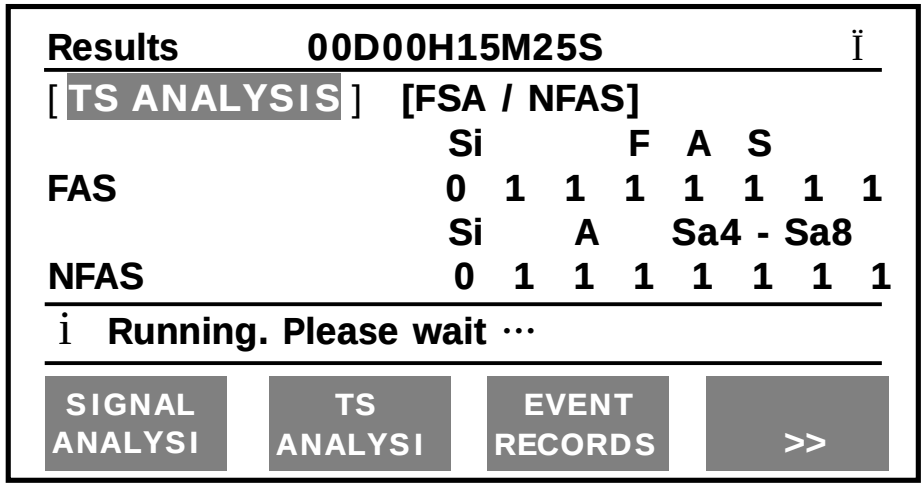
Results 00D00H15M25S
[TS ANALYSIS] [FSA / NFAS]
Si F A S
FAS 0 1 1 1 1 1 1 1
Si A Sa4 - Sa8
NFAS 0 1 1 1 1 1 1 1
Running. Please wait …
SIGNAL ANALYSI
TS ANALYSI
EVENT RECORDS
>>

Fig 41: "TS Analysis" result menu

TS Analysis result item	Framing			
	PCM30	PCM30 CRC	PCM31	PCM31 CRC
FAS/NFAS	·	·	·	·
Mframe	·	·		
TS16 Analysis			·	·
TS Monitor	·	·	·	·
Activity	·	·	·	·

Table 44: Effects of framings on "TS Analysis"

- **"FAS/NFAS"**

"FAS / NFAS" analysis result menu displays different contents according to the CRC4 and non-CRC4 framing. The frame structure of PCM30, PCM30CRC, PCM31 and PCM31CRC are described in Appendix A. Before the measurement, the user should know the framing used by the equipment under test.

"FAS / NFAS" analysis displays of PCM30 or PCM31 framing is as shown in Fig 42.

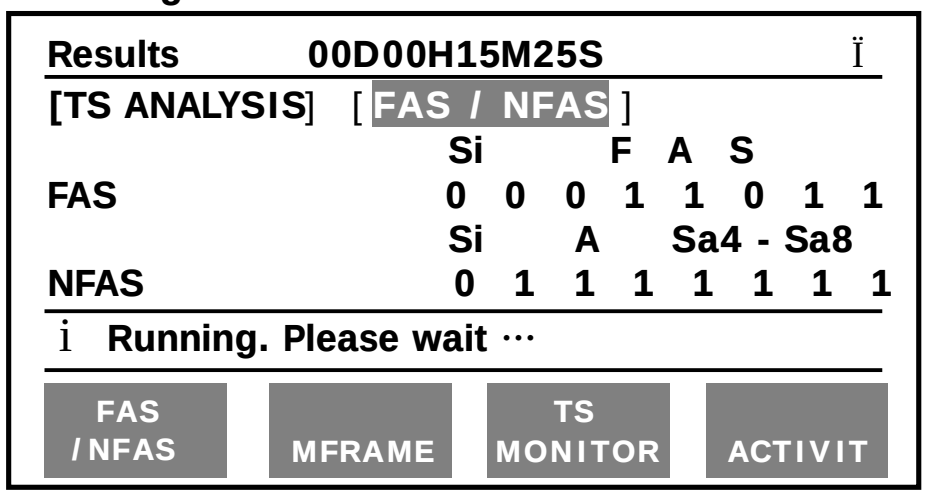
Results 00D00H15M25S
[TS ANALYSIS] [FAS / NFAS]
Si F A S
FAS 0 0 0 1 1 0 1 1
Si A Sa4 - Sa8
NFAS 0 1 1 1 1 1 1 1
Running. Please wait ···
FAS / NFAS
MFRAME
TS MONITOR
ACTIVIT

Fig 42: "FAS / NFAS" in PCM30/31 framing

"FAS / NFAS" analysis displays of PCM30 CRC or PCM31 CRC framing is as shown in Fig 43.

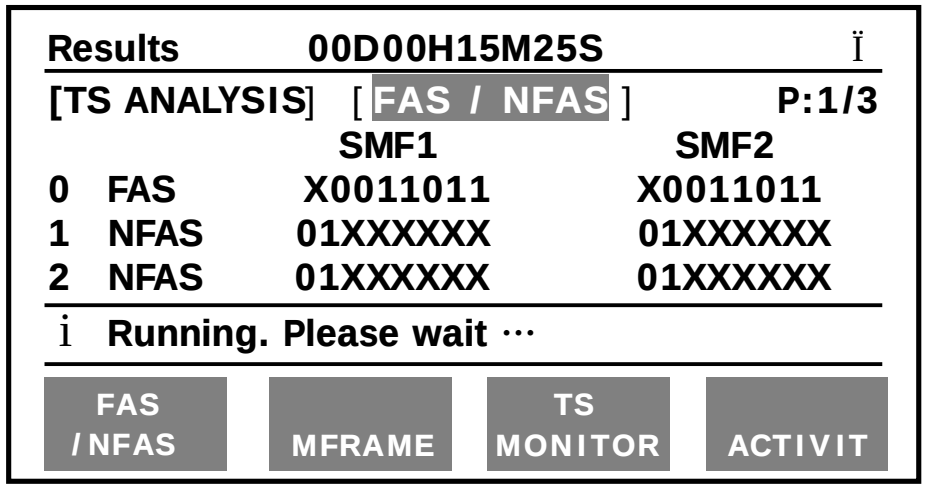

Fig 43: "FAS / NFAS" in PCM30/31 framing

- **"MFRAME"**

"MFRAME" is only valid for PCM30 or PCM30CRC framing. In this menu, user can monitor MFAS and NMFAS word and 4-bit ABCD signaling words (TS01～TS15, TS17～TS31), as shown in Fig 44 (4 pages in all).

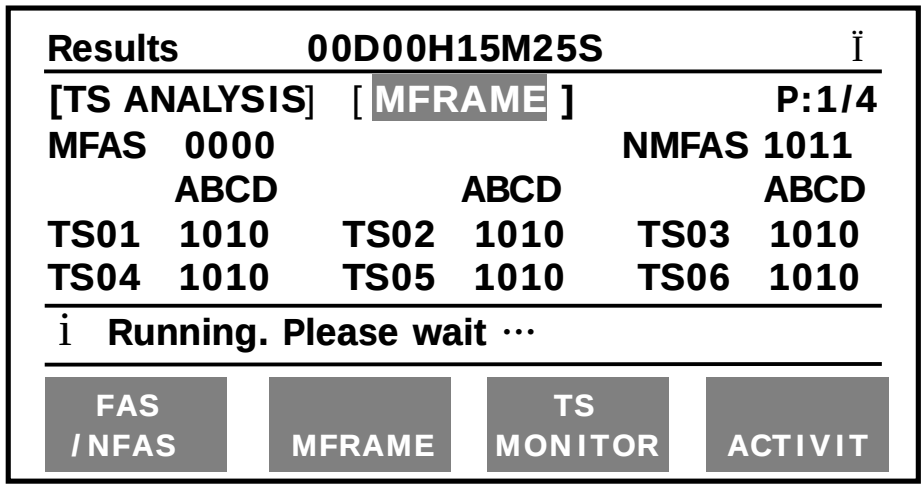

Fig 44: "MFRAME" in PCM30/CRC framing

- **"TS16"**

"TS16" is only valid for PCM31 or PCM31CRC framing. In this menu, user can monitor the data of timeslot 16 in F01～F16 multiframes, as shown in Fig 45 (3 pages in all).

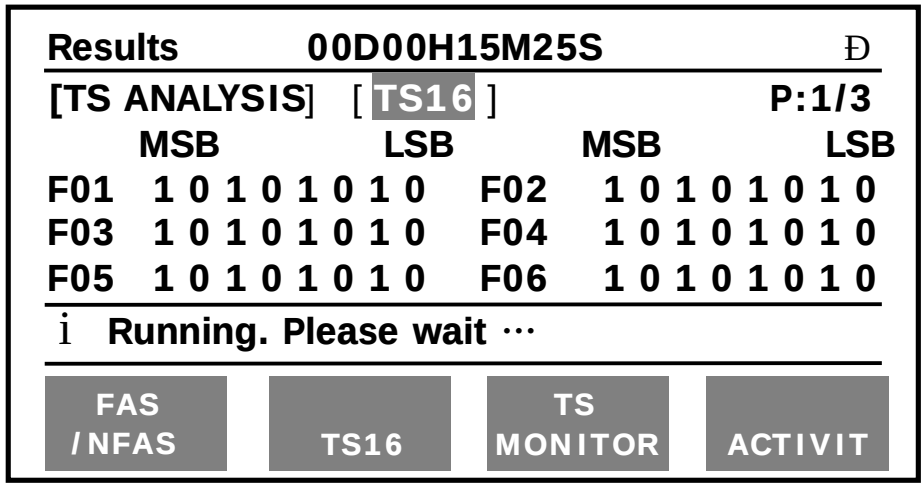
Results 00D00H15M25S
[TS ANALYSIS] [TS16] P:1/3
MSB LSB MSB LSB
F01 1 0 1 0 1 0 1 0 F02 1 0 1 0 1 0 1 0
F03 1 0 1 0 1 0 1 0 F04 1 0 1 0 1 0 1 0
F05 1 0 1 0 1 0 1 0 F06 1 0 1 0 1 0 1 0
Running. Please wait …
FAS /NFAS
TS16
TS MONITOR
ACTIVIT

Fig 45: "TS16" in PCM31/CRC framing

- **"TS Monitor"**

"TS Monitor" is valid for all framings and provides 64 kb/s data channel monitoring updated every one second. The 8-bit binary word and hex word of the timeslot selected will be displayed in real time, as shown in Fig 46.

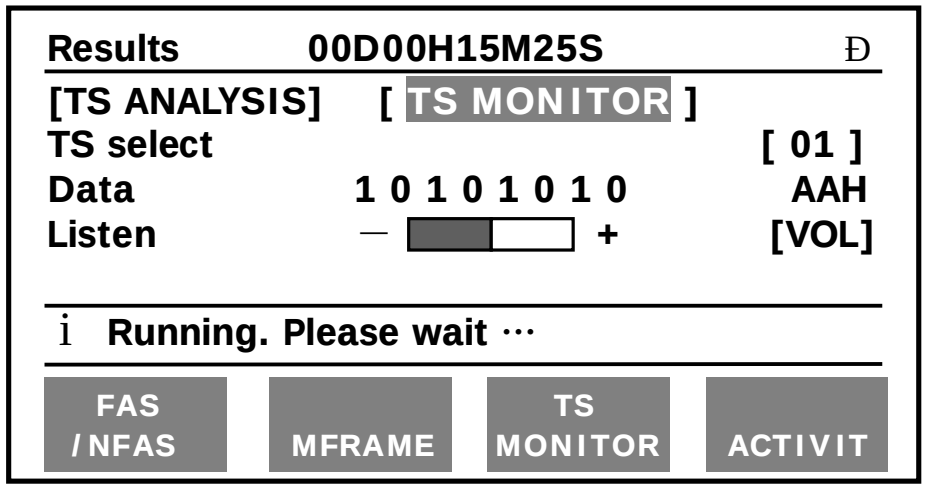

Fig 46: "TS Monitor" in "TS Analysis"

- **"ACTIVITY"**

"Activity" is valid for all framings and provides the activity monitoring for all 64 kb/s data channel. In PCM30 or PCM30 CRC framing, timeslot 16 contains the frame alignment of multiframe, information necessary for switching and routing all 30 telephone channels. So it is not valid for timeslot activity monitoring. All the timeslot activities are displayed with "B" (busy) and "I" (idle). The busy or idle status of timeslot is achieved by monitoring the 8-bit data of every timeslot in real time. If the 8-bit data of certain timeslot is consistent with the idle code which can be set in "Settings" menu of the instrument, then that timeslot status is "idle", otherwise it is "busy", as shown in Fig 47.

64 kb/s data channels are more frequently used than the traditional speech channels in E1 signals. So the method to make the estimation of channel activities is transited from traditional 4-bit signaling ABCD word monitoring to timeslot data monitoring. In the instrument, the status of timeslot "idle" can be defined by programming the idle pattern in "Settings" menu.

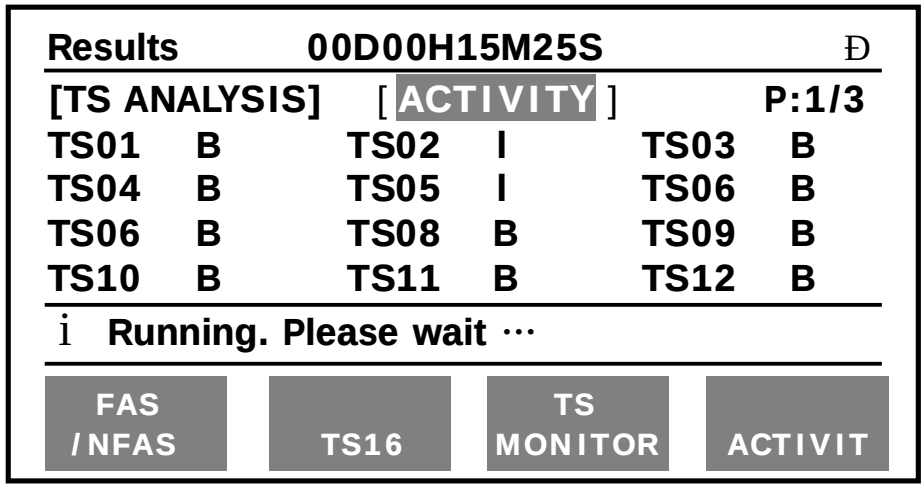

Fig 47: "Activity" in "TS Analysis"

3.3.1.3 "Results" Menu in E1 "Through" Mode

The result menus in E1 "Through" mode are same with the result menus in E1 "RX HI-Z" mode. Please refer to Section 3.2.1.2 for details.

3.3.1.4 "Results" Menu in E1 "Loop Delay" Mode

The result menu displays the delay time of E1 signal in one round trip with maximum measurement delay of 2s (second) in the accuracy of ±1μs (microsecond), as shown in Fig 48. In the menu, user should make the measurements by pressing "F1". If the delay time exceeds the maximum or the line is out of service, the information will appears on the prompt line.

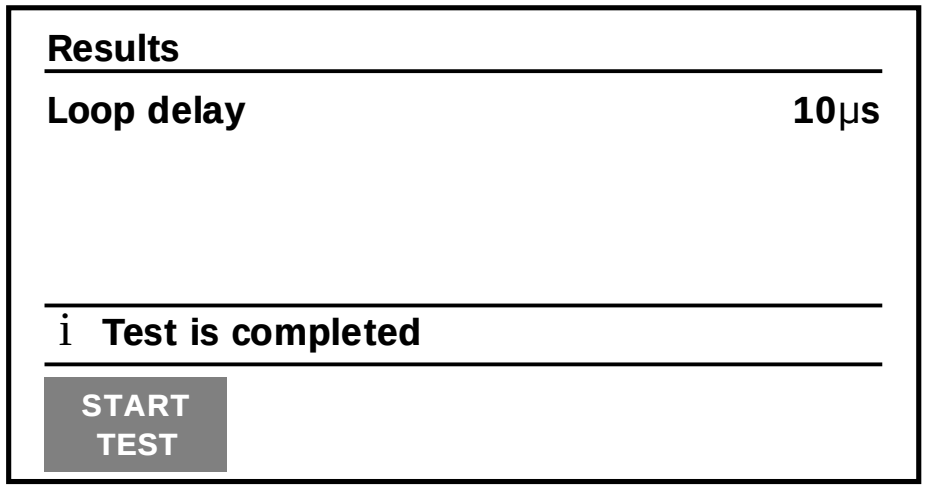

Fig 48: "Loop Delay" result menu

3.3.1.5 "Results" Menu in E1 "APS Delay" Mode

The result menu displays the delay time of E1 signal when the system under test making APS with maximum measurement delay of 2s (second) in the accuracy of ±1μs (microsecond), as shown in Fig 49.

In the menu, user should make the measurements by pressing "F1". If the delay time exceeds the limitation or the APS condition is not reachable, the information will appears on the prompt line.

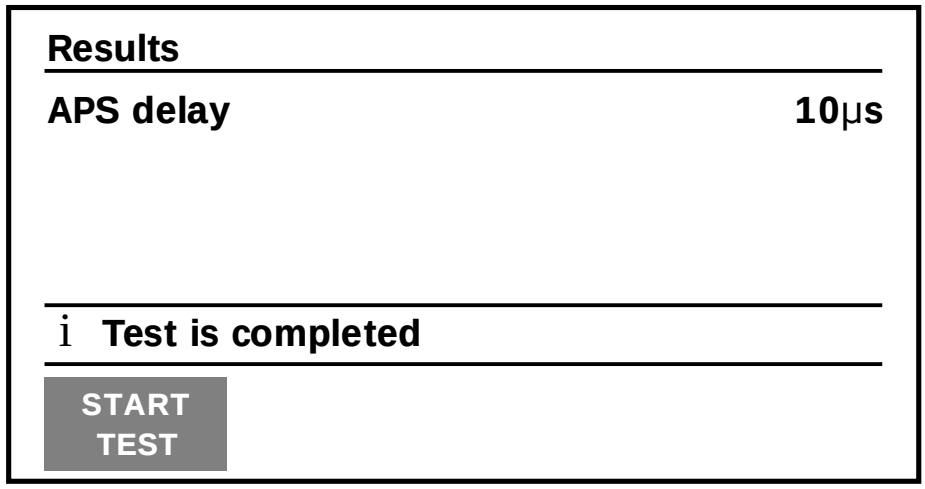

Fig 49: "APS Delay" result menu

3.3.1.6 "Results" Menu in E1 "PCM Simulator" Mode

"PCM Simulator" only provides errors, alarms, VF tone insertion and other analysis for framed E1 signals. Therefore the results menu includes "Errors Count", "Alarm Seconds", "Signal Analysis", "TS Monitor", please refer to Section 3.3.1.1 for details.

In "TS Monitor" menu, VF tone frequency and level measurement results of the timeslot selected is added.

3.3.2 "Datacom" Result Menu

When making measurements with the datacom interfaces, the result menu provides "Basic Analysis", "G.821 Analysis", "Alarm Seconds", "Signal Analysis" and "Event Records". User can select different analysis by pressing "F1", "F2", "F3", "F4" softkeys, as shown in Fig 50.

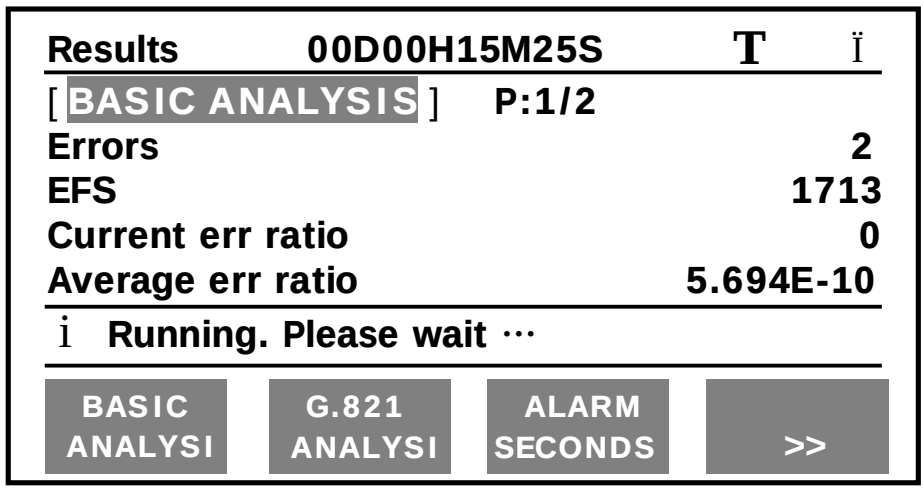

Fig 50: Page 1 of "Basic Analysis" in "Datacom"

"Basic Analysis" performs result statistics of error count, error free seconds, current error ratio, average error ratio,

errored block count and errored block ratio for BIT.

"Basic Analysis" result menus are as shown in Fig 50, 51. The relevant result analysis items are described in Table 45.

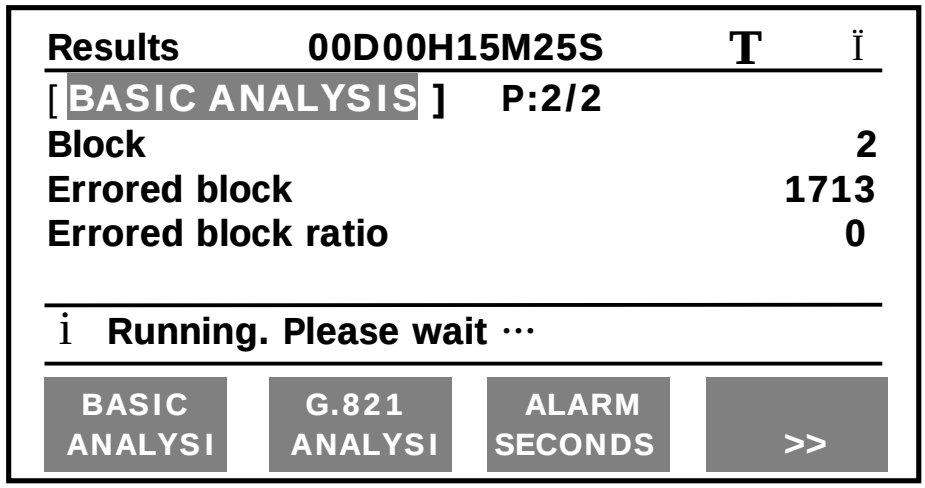

Fig 50: Page 2 of "Basic Analysis" in "Datacom"

Result Analysis	Item	Test result description
Basic Analysis	Errors	The number of BIT errors counted over the elapsed time.
	EFS (% EFS)	Error Free Seconds are counted for the BIT source over total elapsed time in seconds. % Error Free Seconds is the number of error free seconds during a test period expressed as a percentage of the elapsed seconds.
	Current err ratio	Current Error Ratio is the error ratio measured over the last second.

	Average err ratio	Average Error Ratio is the error ratio measured over total elapsed time.
	Block	The number of blocks counted over the elapsed test period. The default block length is supplied by the instrument.
	Errored block	The number of blocks errors counted over the elapsed test period. Block error is defined as a block in which one or more BIT errors occur.
	Errored block ratio	The ratio of block errors counted to blocks received over the elapsed test period.

Table 45: "Basic Analysis" descriptions in "Datacom"

- "G.821 Analysis" result menu is the same as the one in E1 "TX/RX" mode.
- "Alarm Seconds" result menu is as shown in Fig 52 and the result analysis items are described in Table 46.
- "Signal Analysis" result menu is the same as the one in E1 "TX/RX" mode without frequency offset calculation feature.
- "Event Records" result menu is the same as the one in E1 "TX/RX" mode.

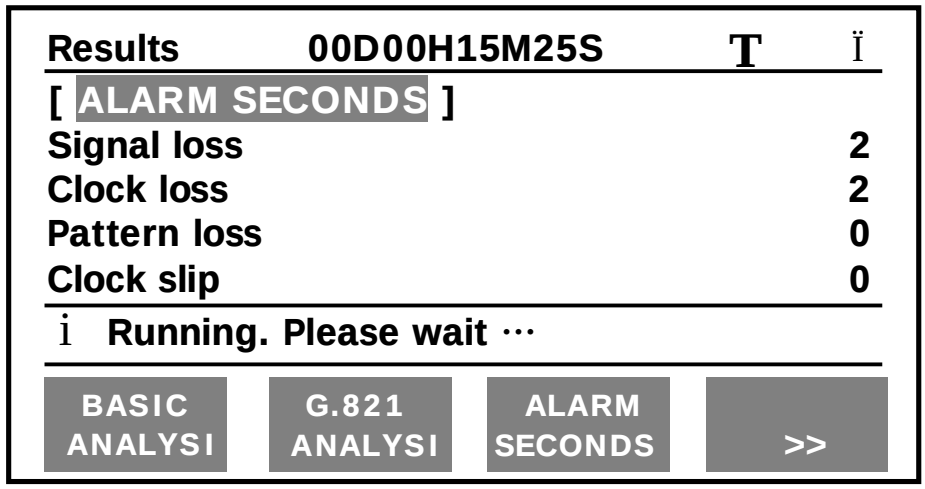

Fig 52: "Alarm Seconds" in "Datacom"

Item	Description
Signal Loss	The number of seconds during which signal loss was detected, counted over the elapsed test period.
Clock Loss	The number of seconds during which clock loss was detected, counted over the elapsed test period.
Pattern Loss	The number of seconds during which pattern loss was detected, counted over the elapsed test period.
Clock Slip	The number of seconds during which clock slips were detected, counted over the elapsed test period. Only provided in PRBS test patterns.

Table 46: "Alarm Seconds" descriptions in "Datacom"

In the synchronous transmission system, the data signals are always clocked in or out with the clock signals. And these two types of signals are synchronous transmitted and received on

separate pairs of circuits. Therefore, "Signal Loss" alarm of the instrument in "SYNC" mode can not be judged only by the received data signals, especially when received data is all "0" or all "1". The judgment rules of "Signal Loss" and "Clock Loss" in synchronous datacom interface are described in Table 47. The example clock signals in Table 47 apply to all the datacom interfaces, but for simplicity only the V.24 circuit names are used. Please refer to Appendix B for the pin-assignments of the datacom interfaces.

<table>
<tr><th>Item</th><th>Emulation</th><th colspan="2">Judgment basis</th></tr>
<tr><td rowspan="2">Signal Loss</td><td>DTE</td><td colspan="2" rowspan="2">No effective data is detected, and at the same time there is no receive clock signal. If the received data is all "1" or all "0", but the receive clock signal still exists, then it should not be judged as a signal loss.</td></tr>
<tr><td>DCE</td></tr>
<tr><td rowspan="6">Clock Loss</td><td rowspan="3">DTE</td><td>TX clock source</td><td>Clock signals detected</td></tr>
<tr><td>Internal</td><td>No TC</td></tr>
<tr><td>RX CLK</td><td>No TC or no RC</td></tr>
<tr><td rowspan="3">DCE</td><td>RX clock source</td><td>Clock signals detected</td></tr>
<tr><td>RX CLK</td><td>No XTC</td></tr>
<tr><td>Internal</td><td>No receive clock signal is needed to detect</td></tr>
</table>

Table 47: Judgment rule of Signal/Clock loss in "SYNC" mode

The clock signals of typical V.24 interface shown above are:

XTC: Transmit clock sourced from DTE

TC: Transmit clock sourced from DCE

RC: Receive clock sourced from DCE

The settings of synchronous clock configuration referring to "Tx clock source", "Rx clock source" and the valid edge need to be determined according to the clock configurations of the system under test, therefore the judgment of clock loss should be determined according to the specific conditions. For the clock configurations, please refer to the relevant parts of Performing Measurements in the next chapter.

3.3.3 "G.703 CO" Result Menu

When making measurements with G.703 co-directional interfaces, the result menu provides "Basic Analysis", "G.821 Analysis", "Alarm Seconds", "Signal Analysis" and "Event Records". User can select different analysis by pressing "F1", "F2", "F3", "F4" softkeys.

- **"Basic Analysis" result menu is the same as the one in datacom "TX/RX" mode.**
- **"G.821 Analysis" result menu is the same as the one in E1 "TX/RX" mode.**
- **"Alarm Seconds" result menu is as shown in Fig 53 and "Octet loss" is added to make counts of octet timing loss.**
- **"Signal Analysis" result menu is the same as the one in E1 "TX/RX" mode.**

- "Event Records" result menu is the same as the one in E1 "TX/RX" mode.

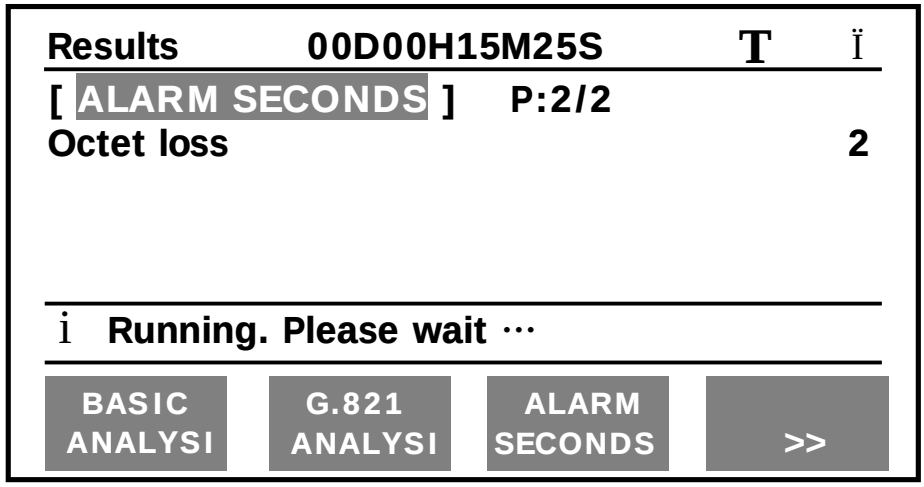

Fig 53: Page 2 of "Alarm Seconds" menu in G.703 CO

3.3.4 "Protocol Converter" Result Menu

When making measurements with a protocol converter, the result menu provides "Basic Analysis", "G.821 Analysis", "G.826 Analysis", "M.2100 Analysis", "Alarm Seconds", "Signal Analysis" and "Event Records". User can select different analysis by pressing "F1", "F2", "F3", "F4" softkeys.

The result displays in "Protocol Converter" is relative to the settings of "Rx interface" as described below.

- When "RX interface" is selected as E1, the result menus are the same as the ones in "E1".
- When "RX interface" is selected as Datacom, the result menus are the same as the ones in "Datacom".
- When "RX interface" is selected as G.703 CO, the result menus are the same as the ones in "G.703 CO".

3.4 "Storages" Menu

"Storages" menus provide following functions:

- Recall the stored settings to make the settings of a test automatically. Modify some parameters and the user settings can be saved or recalled.
- After making the settings, choose "Storage" item as YES to save the results of this test and start the test. When the test is completed, the LCD displays will auto switch to the storage menu, user can define the record's name of this result and choose whether to save this test record or not. If user choose not to save this result, press "F4" to select EXIT to exit the storage menu. If user choose "Storage" item as NO in "Settings" menu, this test result will not be saved automatically, the storage displays will no appear when the test is completed. In the case of that, user can also save the current result in the "Storages" menu later.
- View, lock, unlock and delete the stored settings or results.

Press the "Storage" key to switch to "Storages" menu, and choose SETTINGS, RESULTS to enter into the menus. We will describe them respectively below.

3.4.1 "Settings" in "Storage" Menu

The instrument can save the settings of the test. User can directly recall those stored settings to set up the test. The instrument provides sets of default settings when manufactured in factory. Thus the user can simplify the setting

process. The settings storage menu is as shown in Fig 54.

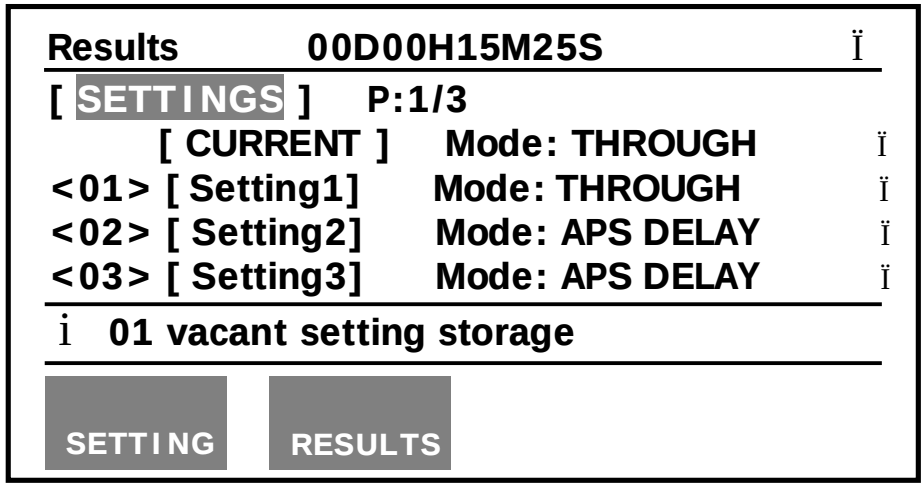
Results 00D00H15M25S Ï
[SETTINGS] P:1/3
[CURRENT] Mode: THROUGH ï
<01> [Setting1] Mode: THROUGH ï
<02> [Setting2] Mode: APS DELAY ï
<03> [Setting3] Mode: APS DELAY ï
i 01 vacant setting storage
SETTING
RESULTS

Fig 54: "Settings" storage menu

a. "Current" Setting

As shown in Fig 55, the current setting appears only in the first page. When STORE is chosen, displays as shown in Fig 56 will appear. After named the current setting, the instrument will save the setting as the name with " Ï " (lock) followed.

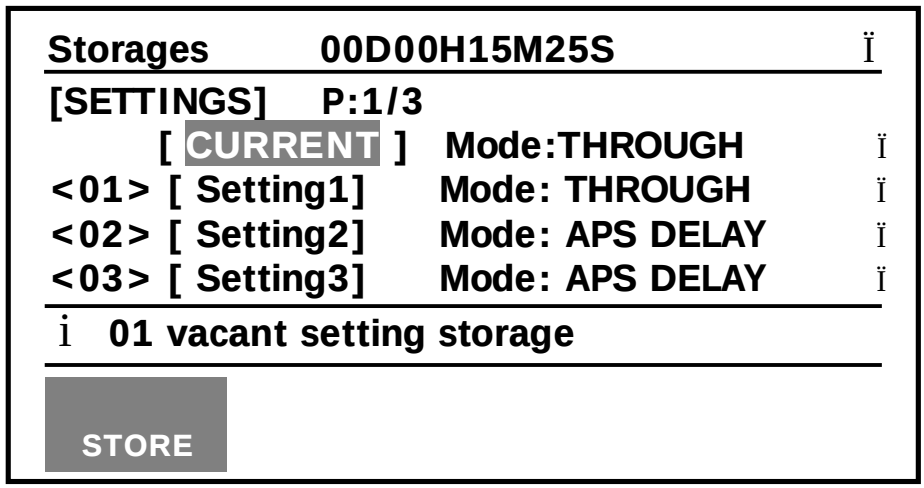
Storages 00D00H15M25S Ï
[SETTINGS] P:1/3
[CURRENT] Mode:THROUGH ï
<01> [Setting1] Mode: THROUGH ï
<02> [Setting2] Mode: APS DELAY ï
<03> [Setting3] Mode: APS DELAY ï
i 01 vacant setting storage
STORE

Fig 55: "Current" setting

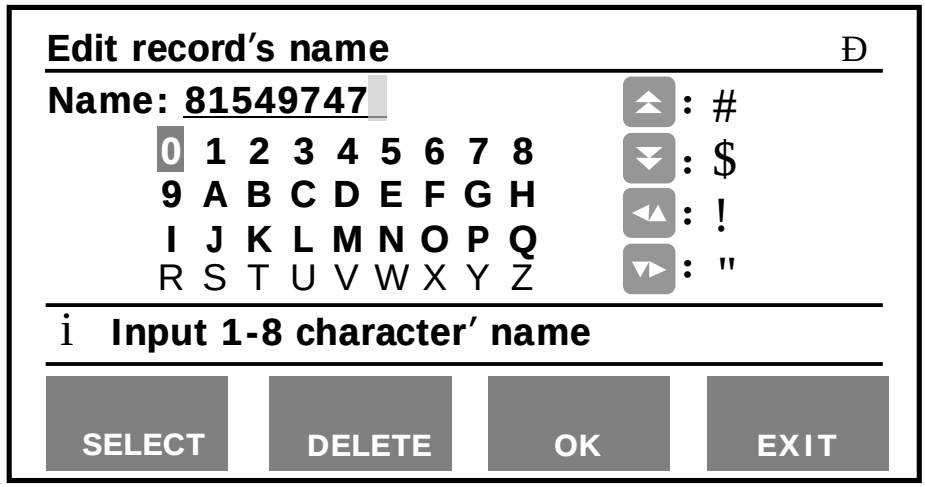

Fig 56: Edit the record's name

b. Stored Settings

The stored settings are numbered as shown in Fig 57. User can view, recall, rename and delete the stored settings as described in Table 48.

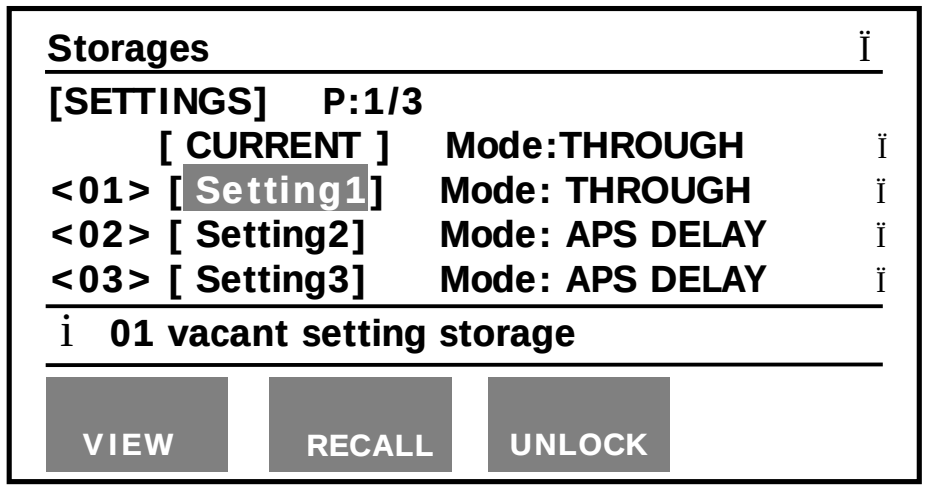

Fig 57: Stored settings

If the stored setting is marked with "Ï", user can only make the activities of view, recall and unlock.

If the stored setting is marked with "Ð", user can make the activities of view, recall, lock, rename and

delete.

The capacity of settings storage is limited. The maximum number of stored settings is 10, among which 8 sets are available as system default settings and 2 sets left to the user to define. If the user wants to save more settings, it is necessary to delete existing stored ones firstly, then directly save the results or save the "Current" setting. The default name of the stored setting given by the instrument is identified as the current time in the string format of "Date Hour Minute Second", such as "18154947".

Item	Description
View	View the settings information of the stored setting.
Recall	Recall the stored setting as the current to set up a new test.
Lock	Lock the selected stored setting in order to prevent it from being accidentally renamed and delete.
Unlock	Unlock the selected stored setting in order to rename and overwrite it.
Rename	Modify the name of selected stored setting.
Delete	Delete the selected stored setting.

Table 48: Activities to the stored settings

3.4.2 "Results" in "Storage" Menu

The result storage menu allows the test results to be saved, or the relevant information of the test result to be viewed

according to the name of the result. The result storage menu is as shown in Fig 58, in that menu, user can save current test result, view, rename and delete stored results saved. The instrument can save up to 10 sets of results.

a. "Current" Result

As shown in Fig 59, the current result appears only in the first page. When STORE is selected, the displays shown in Fig 56 will appear. After named the current result, the instrument will save the result as the name with " Ï " (lock) followed.

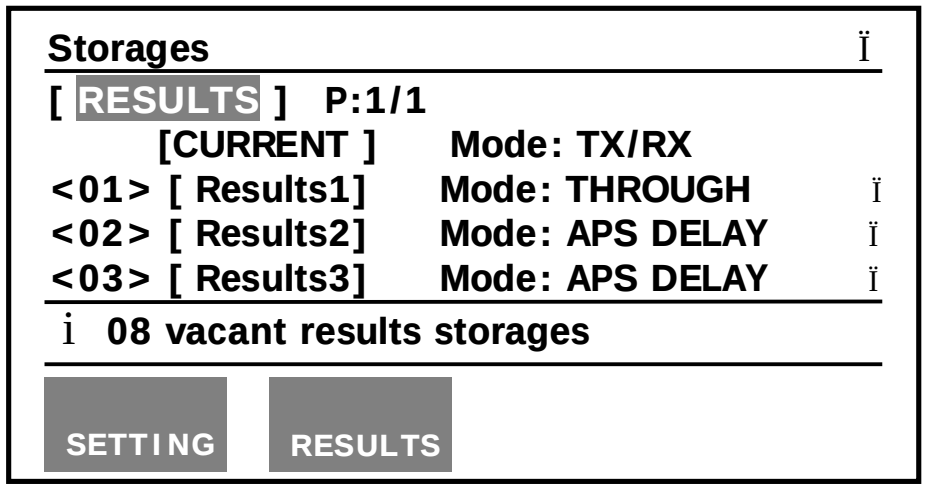

Fig 58: "Results" storage menu

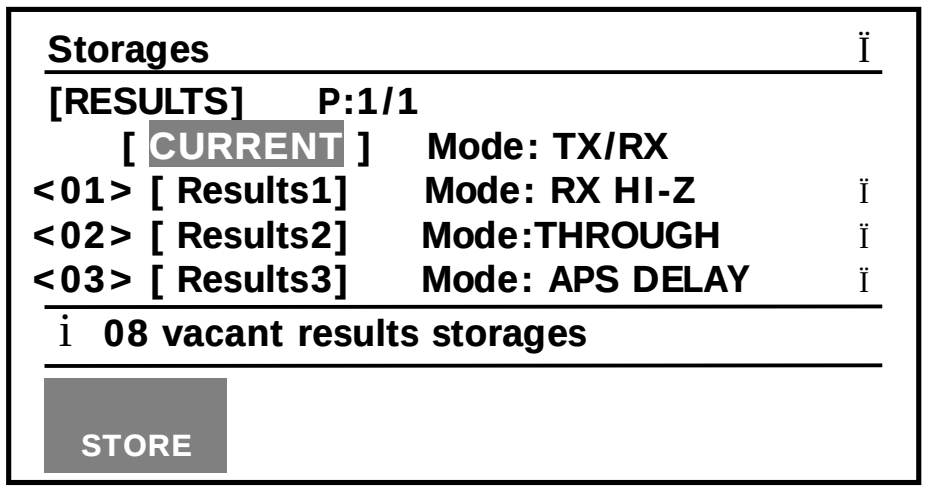

Fig 59: "Current" result

b. Stored Results

The stored results are as shown in Fig 60. User can view, rename and delete the stored results as described in Table 49.

Every stored result consists of full information about the settings, results and time. All the information can help the user in analysis of one valued test.

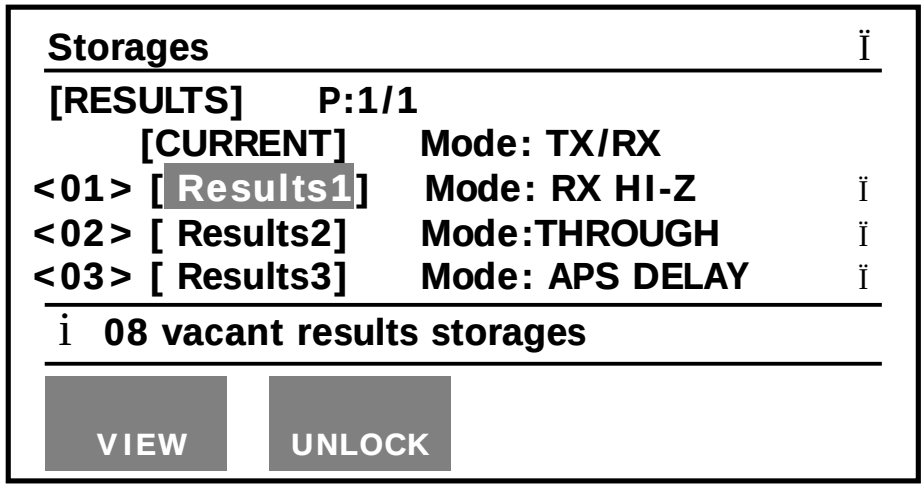

Fig 60: Stored results

When the result is chosen to be saved after the test is completed and there is no more saving capacity, user can exit the "Edit record's name" menu first. At the same time, the result information will be saved in the "Current" result. Then delete the unvalued results to release the capacity and save the "Current".

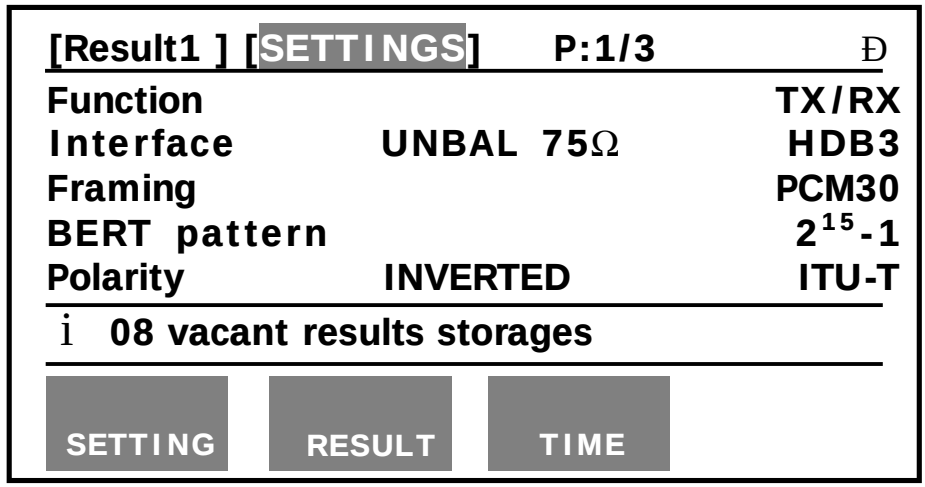

Fig 61: Setting information of stored results

Item	Description
View	View full information of the stored result.
Lock Unlock	Lock the selected result in order to prevent it from being accidentally renamed and overwritten. Unlock the selected result in order to rename and delete it.
Rename	Modify the name of selected result.
Delete	Delete the selected result.

Table 49: Activities to the stored results

3.5 "Others" Menu

"Others" menu mainly performs the settings of other relevant parameters of the instrument. User can make configurations according to the real needs.

Press the "Other" key to switch to "Others" menu. "Others" menu provides the accessorial functions of MISCELLANEOUS, POWER MANAGER, RS232 PORT, TIME&DATE, KEYBOARD TEST, SELF TEST, TESTER INFO, PRODUCER INFO. These

functions will be described respectively below.

3.5.1 "Miscellaneous"

"Miscellaneous" menu is as shown in Fig 62, provides "Beep on alarm", "Keyboard lock", "Display EFS or %EFS", "Language" and "Load default settings" parameters, and relevant parameters are described in Table 50.

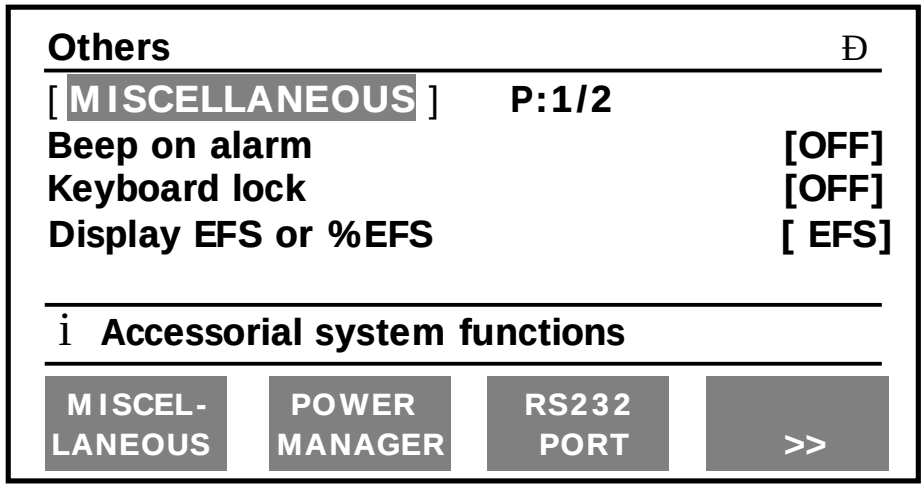

Fig 62: "Miscellaneous" menu

Item	Option	Description
Beep on alarm	ON	Beep on alarm and error.
	OFF	No beep on alarm and error anyway.
Keyboard lock	ON	To lock the "START/STOP" key, can not be used when the test has not been started yet (the "START/STOP" indicator turns off). Only valid after the test is started (the "START/STOP" indicator turns on).
	OFF	Release the keyboard lock.

Display EFS or %EFS	EFS	Error free second displays as the number of count.
	%EFS	Error free second displays as a percentage of the elapsed seconds.
Language	中文简体	Simplified Chinese displays.
	ENGLISH	English displays.
Load default settings	YES	Restore the instrument with the default factory settings.

Table 50: "Miscellaneous" configurations

3.5.2 "Power Manager"

As shown in Fig 63, the instrument provides the functions to save the power. "Power Manager" menu allows the user to set "Auto power off", "Auto backlight off" parameters by pressing "F1" and "F2" softkeys. The relevant parameters are described in Table 51.

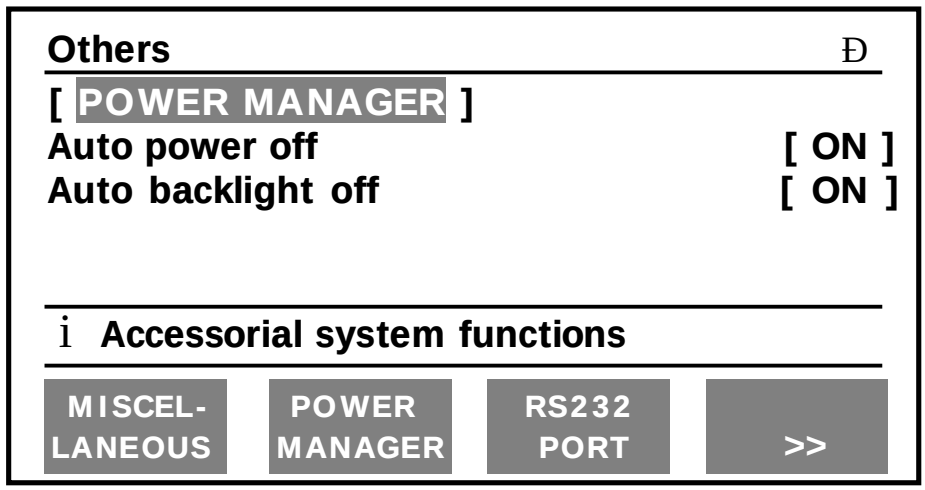

Table 63: "Power Manager" menu

When a test is controlled by timer which set in "Settings" menu, please set "Auto power off" as OFF in order to prevent the instrument auto shut off before the test can be automatically started by the timer.

Item	Option	Description
Auto power off	ON	When the instrument is not under the test-started status and there is no keystroke for 5 minutes running, the instrument will be automatically shut off.
	OFF	The automatic shutdown function is disabled.
Auto backlight off	ON	Press the "Backlight" key to open the backlight, the backlight will be automatically turned off in 30 seconds.
	OFF	The automatic backlight shutdown function is disabled.

Table 51: "Power Manager" configurations

3.5.3 "RS232 Port"

As shown in Fig 64, before uploading the stored results in the instruments or upgrading the embedded software by TestManager, user should configure the RS232 port firstly as

described in Table 52.

RS232 Port	Option	Description
Port State	ON	The instrument can communicate with PC via RS232 interface.
	OFF	The communication with PC via RS232 interface will be prohibited.

Table 52: "RS232 Port" configurations

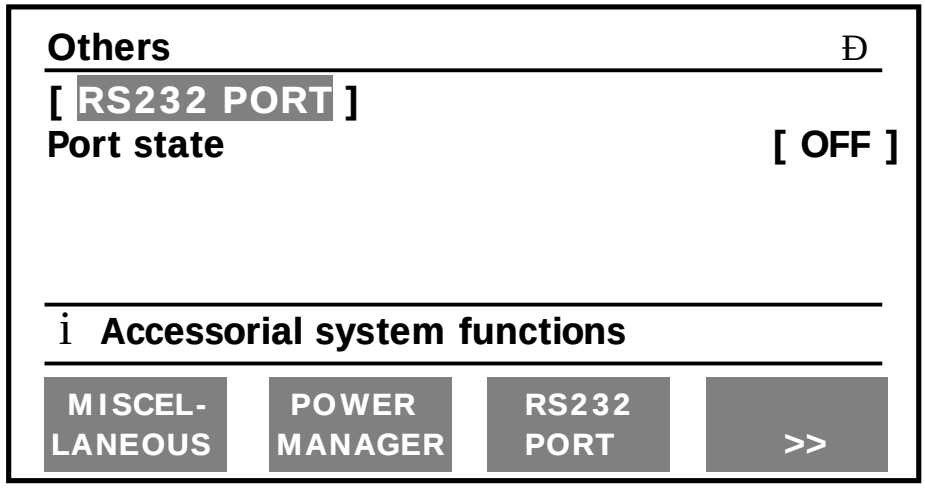

Fig 64: "RS232 Port" menu

When the RS232 port state is configured as ON, other operations of the instrument will be disabled. The displays will be locked temporarily before the port state becomes OFF. Please disable the port state as OFF when the communication with PC is completed, to perform other operations.

3.5.4 "Time & Date"

When recording results, it is useful to have certain events time-stamped, for example Alarms and Error Seconds. As

shown in Fig 65, user can set up the new time and date as described in Table 53.

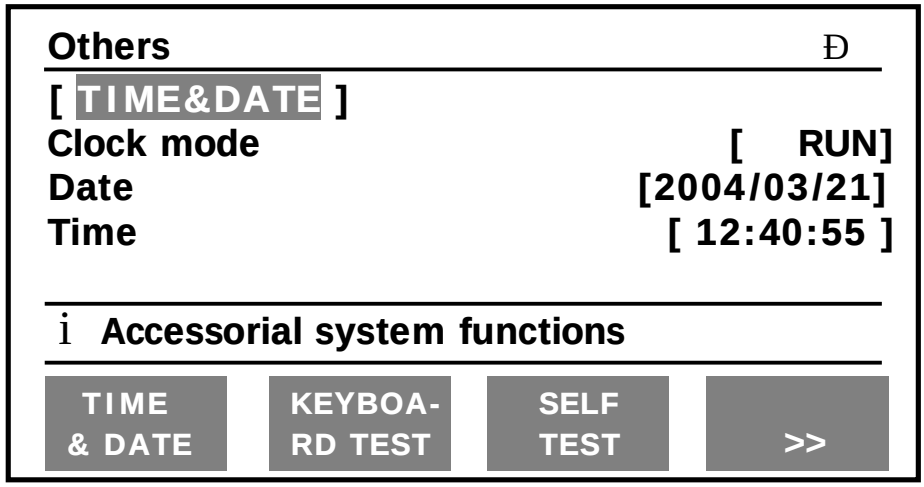

Fig 65: "Time & Date" menu

Time&Date	Option	Description
Clock Mode	RUN	To run the new real-time clock after the modification of the date and time.
	SETUP	Modify the date and time of the instrument.
Date	Year	Select between 2000～2099.
	Month	Select between 01～12.
	Date	Select between 01～31.
Time	Hour	Select between 00～23.
	Minute	Select between 00～59.
	Second	Select between 00～59.

Table 53: "Time & Date" configurations

3.5.5 "Keyboard Test"

"Keyboard Test" function can detect whether the keyboard of

the instrument functions properly or not. Except for the "Power" key, all other functional keys can be tested.

As shown in Fig 66, the keyboard test can be performed one by one according to the prompt information in displays. In the process of keyboard test, all the functional keys including the "Power" key are locked and only valid for use after the test.

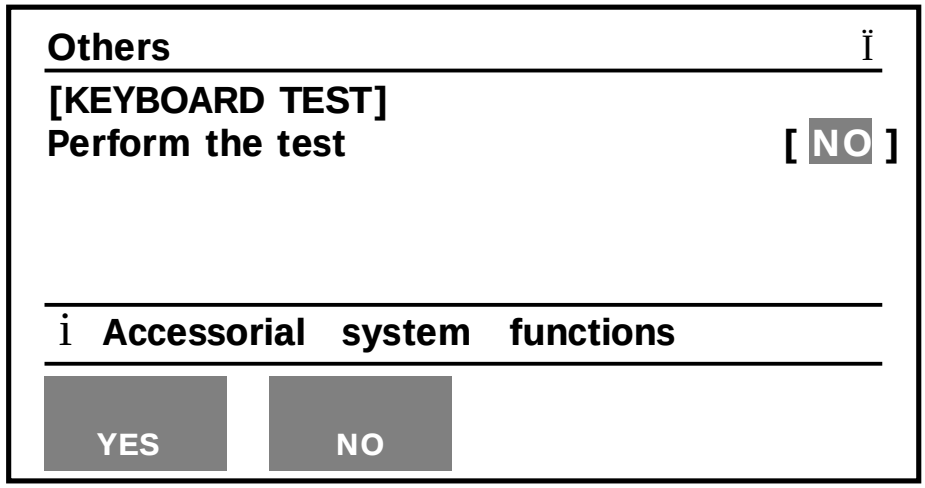

Fig 66: "Keyboard Test" menu

During the keyboard test, if no key stroked by user, then the instrument will keep waiting. When the correct key is stroked, the keys prompted under test will display "√" and the wrong keys will display "×" until all the process is completed. Please follow the prompt information to stroke the corresponding key until the test is completed.

Until the keyboard test is completed, user can not exit.

3.5.6 "Self Test"

Before making measurements, user can run self test to

ascertain the integrity and functions of the instrument.

As shown in Fig 67, the instrument self test is performed one by one according to the functional circuit modules on displays. User can exit the test when the test has completed.

During the self test, the instrument will self-detect the LED indicators, with the steps of turning on all CPU controlled LEDs, then turning all of them off, and finally turning on "SIGNAL LOSS", "FRAME LOSS", "AIS", "MFRAME LOSS", "PATTERN LOSS", "REMOTE ALARM", "ERRORS", "LOW BATTERY" and "START/STOP" indicators in sequence. User can check if the LED indicator is functioning properly according to the above procedures. If user finds one LED indicator can not be turned on or off, the LED indicator may be damaged or out of control. In that case, please contact the instrument supplier as soon as possible. Since the "CHARGE" LED indicator is not controlled by CPU, therefore this LED can not be checked by self test.

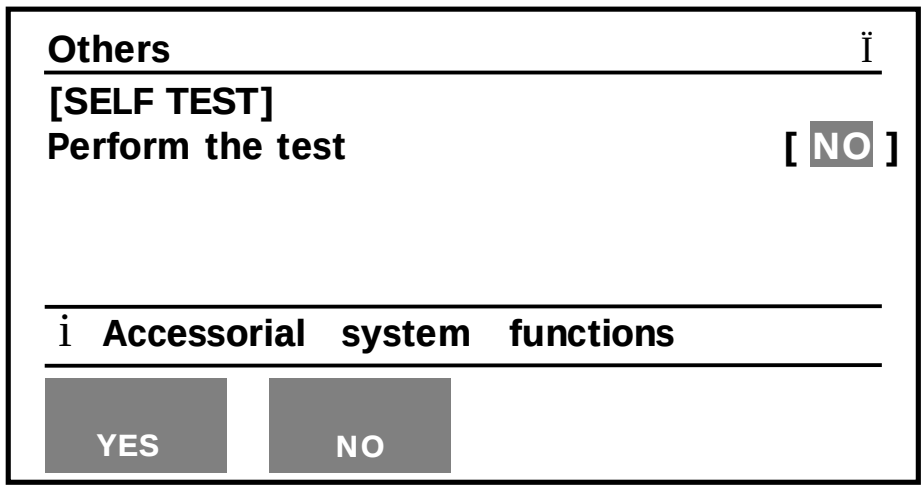

Fig 67: "Self Test" configurations

It will display "√" if the test is ok and display "×" if the test is failed.

User can not exit the self test until the test has completed.

3.5.7 "Tester Info"

"Tester Info" menu displays the serial number code, software version, hardware version and manufacturer and optional function module and other information of the instrument.

3.5.8 "Producer Info"

"Producer Info" menu displays company name, website, service phone, email and other information of the manufacturer.

4 Performing Measurements

This chapter is intended to help the user in performing measurements with E1/Datacom tester. Full details of the measurements and how to perform them will be described below.

4.1. Overview

4.2. Perform the measurements

4.1 Overview

The E1/Datacom tester combines E1 circuit testing function and datacom communication circuit testing function together. With this unique combination, the instrument can be used to make measurements for transmission networks which cover 50b/s～2.048Mb/s bandwidth. It supports more than 10 types of various telecom and datacom interfaces which are widely used in digital networks. E1/Datacom tester is suitable for R&D, manufacturing, installation, certification and maintenance testing of PCM, digital communication equipment and multi-protocol interface converters.

The basic procedure of making measurement is:

a. Select the test interface.

b. Set up the measurement parameters.

c. Perform the measurement.

d. Display or store the results.

e. Upload and analyze the stored results.

4.2 Perform the Measurements

4.2.1 "E1" Service Testing

4.2.1.1 Out-of-service Bit Error Rate Testing

The out-of-service error testing is mainly used in the development, spot installation, spot acceptance and daily maintenance of equipment, can accurately perform measurements of the transmission quality of the system under test. In addition, the instrument will give full analysis on the error, signal, alarm seconds and event records. The out-of-service testing can be made by local loop or far-end loopback and far-end mutual test, as shown in Fig 68 and Fig 69.

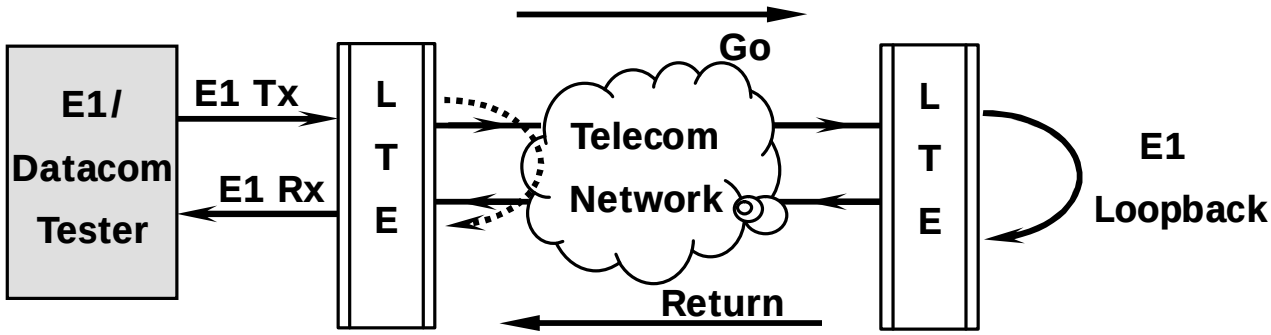

Fig 68: Out-of-service BER Testing (local and Far-end Loopback)

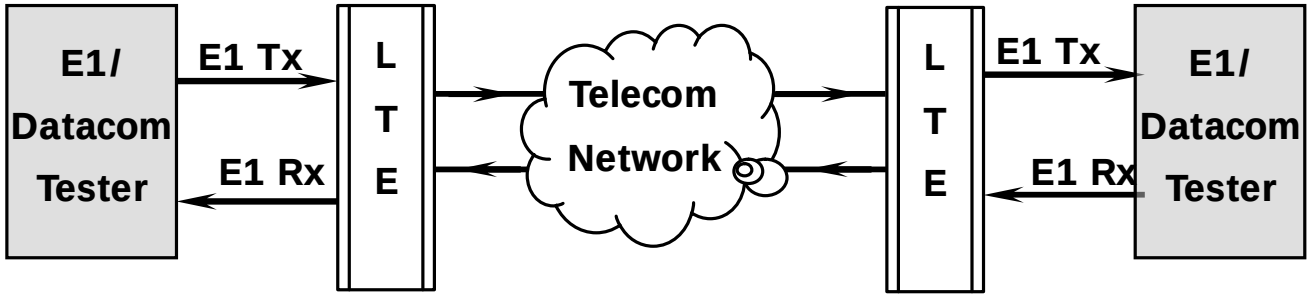

Fig 69: Out-of-service BER Testing (Far-end Mutual Test)

LTE = Line Terminal Equipment of transmission system (PDH, SDH)

Test Description

- **When E1 "TX/RX" mode is chosen, configure the settings according to the specific configurations of the equipment under test. Please refer to relevant part of Section 3.2.1.**

- **After completing the settings, press the "Start/Stop" key and the "Result" key to enter into relevant result menu. The test result is described in Section 3.3.1. The results may be different according to the different settings.**

- **When making loopback test, the loop can be made by loopback interface to network directly at the local equipment under test, or the far-end loopback which can be configured via the maintenance software of the system under test. In out-of-service framed BER testing, if there is no 64K timeslot DXC equipment in the loopback path, the transmit and the receive timeslots need to be set as "TX AS RX". If the DXC equipment is used in the loopback path and the transmit timeslots have been cross-connected, then the receive timeslots need to be determined according to the cross-connected timeslots. At this time, the transmit and the receive timeslots should be set as "DIVERSE".**

- **Pay attention to ensure that the test pattern and pattern polarity of the local and far-end instrument should be set identically in the far-end mutual test.**

- **When making the measurements, error can be inserted**

into the path to verify the operating status of the instrument including the transmitter and receiver.

4.2.1.2 In-service Testing

In applications when the service can not be interrupted, such as the transmission of the real-time accounting information, the user should make the measurements in the in-service testing mode. In-service testing provides monitoring error performance on FAS, CODE, CRC4 and E-BIT. In the measurements, user can also make a listen to any speech channel and monitor timeslot data, CCS or CAS signaling word, frame data such as FAS/NFAS. There are two in-service testing mode including "RX HI-Z" mode and "Through" mode. "RX HI-Z" mode testing connection is as shown in Fig 70. "Through" mode testing connection is as shown in Fig 71.

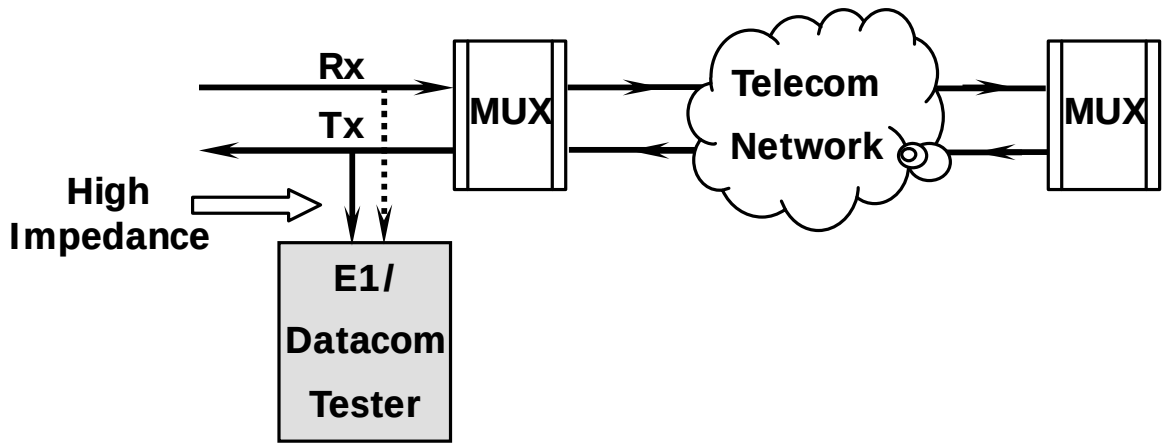

Fig 70: "RX HI-Z" mode in-service testing

MUX = Multiplexer / Demultiplexer

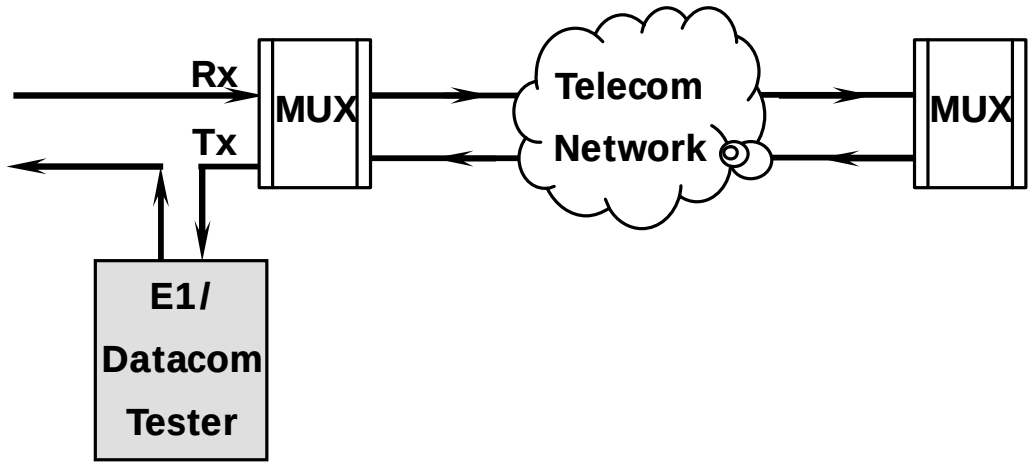

Fig 71: "Through" mode in-service testing

Test Description

- **When E1 "RX HI-Z" mode is chosen, the input impedance of the receiver of the instrument is set under high impedance (>2KΩ). User can directly connect the receiver of the instrument to 2 Mb/s transmission channel with the transmitter or receiver on DDF (Digital Distribution Fame). According to framings of the 2 Mb/s signal under test, select the corresponding frame structure such as Unframed, PCM30, PCM30CRC, PCM31 and PCM31CRC. Please refer to relevant parts of Section 3.2.2 for details.**

- **When completing all the settings, press the "Start/Stop" key and the "Result" key to enter into relevant result menu. All the test results in this mode are described in Section 3.3.2.**

- **When E1 "Through" mode is chosen, the 2 Mb/s signal under test will be transmitted transparently through the instrument. Select Unframed, PCM30, PCM30CRC, PCM31,**

PCM31CRC frame structure according to the 2 Mb/s signal under test. Please refer to the relevant parts of Section 3.2.3 for details. When completing all the settings, press the "Start/Stop" key and the "Result" key to enter into relevant result menu. All the test results in this mode are described in Section 3.3.3.

4.2.1.3 N×64Kb/s Bit Error Rate Testing

Nx64kb/s BER testing is used to check timeslot integrity through the digital cross connect equipment. A test pattern is transmitted over a group of timeslots from the near end. At the far end, the expected receive timeslots are selected and bit error rate is calculated.

The E1 digital cross connection equipment can switch one received timeslot to any timeslot of the other E1. In E1 "TX/RX" mode framed testing, select a group of timeslots in the transmit direction and expected timeslots in the receive direction to make the BER testing. Fig 72 shows one N×64Kb/s BER testing connection.

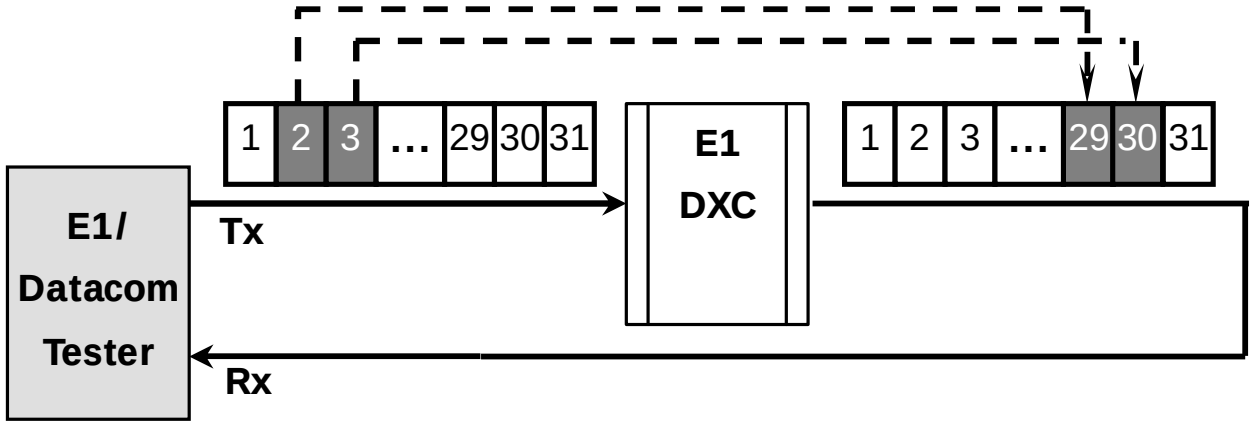

Fig 72: N×64Kb/s BER testing

Test Description

- As shown in Fig 72, the E1 DXC equipment cross connects the 2nd and the 3rd timeslots of one E1 signal to the 29th and the 30th timeslots of another E1 signal. Therefore, user should select the 2nd and the 3rd timeslots in "Tx timeslots" and the 29th and the 30th timeslots in "Rx timeslots". Then the BER testing can be performed in these two timeslots path.

- When making BER measurements in Nx64kb/s mode, "TX/RX" framed testing mode should be configured. Please refer to the relevant parts of the Section 3.2.1.

- When completing all the settings, press the "Start/Stop" key and the "Result" key to enter into relevant result menu. All the test results in this mode are described in Section 3.3.1.

4.2.1.4 "Loop Delay" Measurement

The time taken for voice or data traffic to pass through the network is very important as excessive delay adds distortion. Speech is particularly affected by delays longer than 150 ms. Loop delay means the total round trip delay on the "go" and "return" legs of a duplex path and is typically in the order of microseconds. The instrument measures the time taken for a test pattern to be transmitted over the "go" and "return" legs of a duplex network path. A test pattern is transmitted in an Nx64 kb/s path (or 2 Mb/s unframed path) and a timer is set running. A loopback is manually applied to the network

equipment to return the test signal. The received pattern stops the timer and the round trip delay is calculated. Fig 68 shows a loop delay testing connection.

Test Description

- **Loop delay is only possible at 2 Mb/s line rate.**
- **Connect a loopback to the network equipment.**
- **Set up the settings as described in Section 3.2.4.**
- **When completing all the settings, press the "Result" key to enter into relevant result menu, and then press the "F1" key to start the test.**
- **All the test results are described in Section 3.3.4.**

4.2.1.5 "APS Delay" Measurement

SDH four-fiber and two-fiber optical loop network is usually provided with automatic protection switching (APS) function. When the operating fiber cable line is broken, the SDH equipment can automatically switch the interrupted 2 Mb/s signals to the optical channels of another direction for transmission, to ensure that the communication will not be interrupted. When the equipment performs automatic protection switching, there is a clear limitation to the delay time. And the APS delay measurement is to measure the total time taken for the switching.

Before performing APS action, the equipment usually generates AIS on 2 Mb/s signal firstly. When the instrument receives this AIS alarm, the timer internal is set running and a test pattern will be transmitted into the path under test. The

received pattern stops the timer and APS delay time will be calculated. Fig 68 shows the typical connection.

Test Description

- **Loop delay is only possible at 2 Mb/s line rate.**
- **Set up the settings as described in Section 3.2.5.**
- **When completing all the settings, press the "Result" key to enter into relevant result menu, and then press the "F1" key to start the test.**
- **Wait for the AIS signal and the delay time is calculated.**
- **All the test results are described in Section 3.3.5.**

4.2.1.6 Timeslot Analysis

When performing in-service testing ("RX HI-Z" mode or "Through" mode), not only the error measurement can be tested, but also the data and activities of all 64kb/s timeslot and signaling words in E1 signal can be monitored. Since the timeslot data always carry the speech information, the instrument also provides the listen capability to all the voice channels. Fig 70 and Fig 71 show the examples.

Test Description

- **The settings are described in relevant parts of "RX HI-Z" mode (framed testing) in Section 3.2.2.**
- **In the result menu, user can select the timeslot that needs to be monitored. From the display, both binary and hex format of the data are provided. Please refer to Section 3.3.2 for details.**
- **The frame structure of PCM30, PCM30CRC, PCM31 and**

PCM31CRC are described in Appendix A.

4.2.1.7 "PCM Simulator" Testing

When "PCM Simulator" function is chosen, the E1/Datacom tester can be simulated as PCM equipment. In this mode, the instrument provides various alarm insertion, transmit clock deviation, error insertion, frame data generation, VF tone generation and measurement and so on. In the mean time, the instrument also performs framing bits, signaling bits, spare bits monitoring and signal analysis to the received E1 signal. It is mainly used to check the performance of PCM equipment. For example, the VF tone generation and measurement function can be used to verify the PCM coding and decoding of the equipment. Fig 73 shows a typical connection of "PCM Simulator" testing.

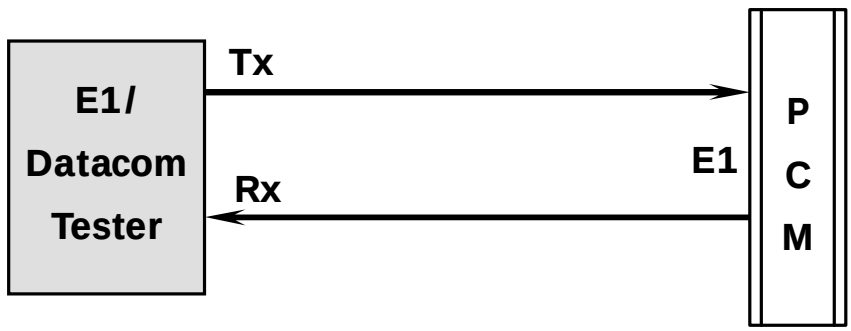

Fig 73: "PCM Simulator" testing

Test Description

- **The settings are described in Section 3.2.6.**
- **All the test results in this mode are described in Section 3.3.6.**

4.2.1.8 Tx Clock Deviation Testing

The transmit clock which sourced from internal synthesizer can be deviated up to ±999 ppm by user with the step of 1ppm step. This function can evaluate the synchronous clock recovery capability of the receiver of the equipment under test.

Test Description

- **The transmit clock deviation testing can be performed in the "TX/RX" mode and "PCM Simulator" mode.**
- **The settings are described in Section 3.2.1 and Section 3.2.6.**
- **All the test results will be displayed in "Signal Analysis" menu.**

4.2.2 "Datacom" Service Testing

The transmission quality of datacom path is mainly evaluated by bit error rate testing which commonly uses Errors, EFS, Current error ratio, Average error ratio statistics indexes. The E1/Datacom tester can perform BER testing and other analysis conveniently to V.24 (RS-232/V.28), V.35, V.36, X.21, RS-485, RS-449, EIA-530, EIA-530A with synchronous and asynchronous test mode. It supports the data rate measurement range from 50b/s ~ 2.048 Mb/s.

In digital transmission system, datacom interfaces (V.24/ RS-232/V.28, V.35, V.36, X.21, RS-485, RS-449, EIA-530 and EIA-530A) are commonly used to interconnect between the narrow band data terminals or networks. These interfaces

have various control circuits including GND, data signals, clock signals and handshaking signals. And all these signals can be classified with single-end and differential signals. The different datacom interfaces have different signals which may be single-end or differential conformed to various voltage level standards such as V.11, V.28 and V.35. For example, the X.21 interface is one datacom interface whose signals are differential transmitted and received conformed electrically to V.11. All the specifications of datacom interfaces are described in the "Technical Specification" chapter.

Before making measurements of datacom interfaces, the key parameters such as "Interface", "Test mode", "Tx data rate" and "BERT pattern" should be configured completely. When making measurements on a synchronous data, clock configurations should be made either. Select the right datacom adapter cables according to the type of the interface and emulation of the instrument.

The connection of datacom service testing is similar to E1. Local loop, Far-end loopback and far-end mutual test can be used to perform measurements, as shown in Fig 74, Fig 75 and Fig 76.

The datacom interfaces are usually provided by the digital equipment such as DTU, MODEM, Loop-carrier system. And the equipment under test in the following figure apply to all above equipment, but for simplicity only the PCM equipment with standard datacom interfaces are used.

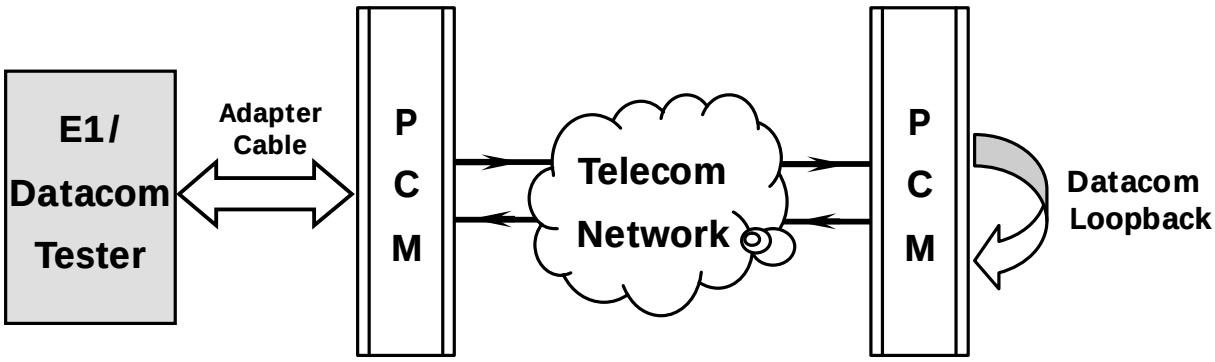

Fig 74: Datacom BER testing (Far-end datacom loopback)

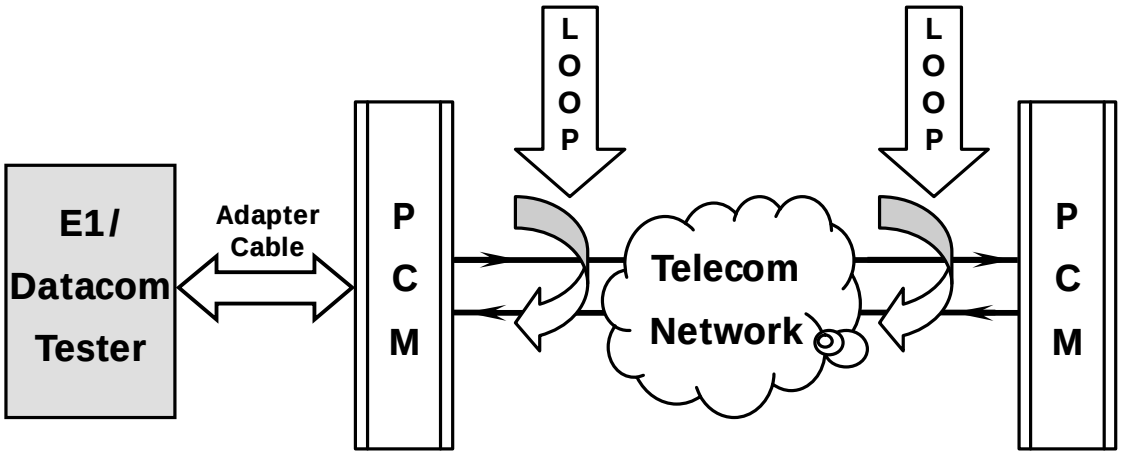

Fig 75: Datacom BER testing
(Local or Far-end network loopback)

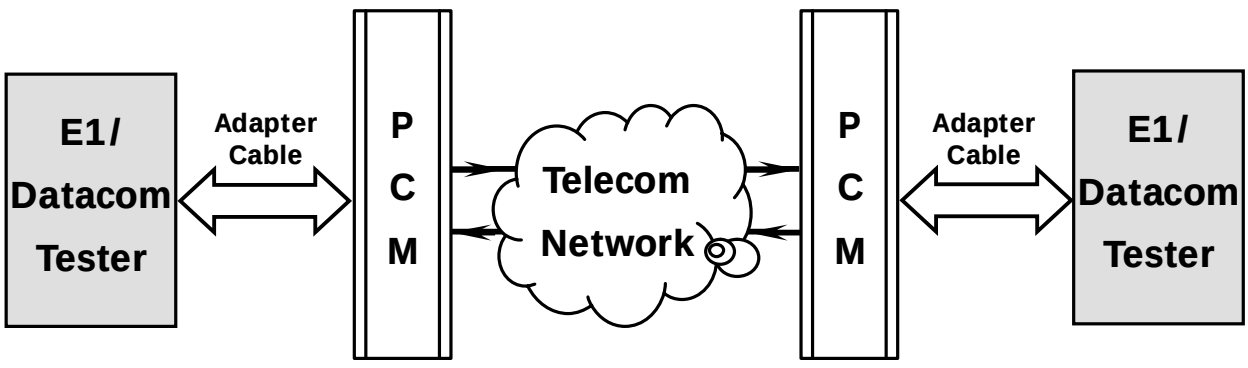

Fig 76: Datacom BER testing (Far-end mutual test)

In the process of measurement, error can be directly inserted into the path via the "Single Error Add" key of the instrument

to verify the operating status of the instrument and the signals transmitted and received in the path.

Test Description:

Results throughout the test period can be acquired from the test result menu, including Basic Analysis (Error, EFS, Current error ratio, Average error ratio, block errors, errored block ratio), Alarm Seconds (Signal loss, Clock loss, Pattern loss, Clock slip), G.821 Analysis, Signal Analysis (Line rate), Event Records, etc.

Some issues to which special attention should be paid in setting test parameters for asynchronous data and synchronous data transmission are described as follows:

a. Making a Measurement on Asynchronous Data

In asynchronous data testing, following parameters of the instrument need to be set, including "Tx data rate", "Character length", "Stop bits", "Parity" and "BERT patter" and "Polarity". Since the clock signal is unnecessary for asynchronous data transmission, the clock configurations and frequency measurement is not provided in this mode.

b. Making a Measurement on Synchronous Data

In synchronous data testing, the instrument can be emulated as a DTE or a DCE according to the emulation of the equipment under test. The emulation of the instrument is the key parameter which can determine other configurations. In one digital network, DCE equipment usually provides the clock to

DTE equipment in order to make all digital equipments working synchronously. Henceforward, special attention should be paid that the synchronous clock source for the transmitter and receiver of the instrument (internal or interface) and valid clock sense (rising edge or falling edge) may be different based on the emulation mode of equipment under test. The relevant configurations are described below.

Ø DTE Mode

When the E1/Datacom tester is configured as a DTE, it can be connected to a DCE (normally a modem or some other data set) making it possible to test the whole datacom circuit from end to end.

Ø DCE Mode

When the E1/Datacom tester is configured as a DCE, it can be connected to terminal equipment for confidence checking. It can also be connected to transmission equipment which has been configured DTE.

Ø Synchronous Clock Configurations

The E1/Datacom tester can use various clock configurations when emulating a DTE or DCE. The examples shown in the illustrations apply to the V.24, X.21, V.35 and other interfaces, but for simplicity only the V.24 circuit names are used.

Abbreviation Explanation:

DTE: Digital Terminal Equipment

DCE: Digital Connect Equipment

RD: Received Data (sourced from DCE)

RC: Receive Clock (sourced from DCE)

TD: Transmitted Data (sourced from DTE)

TC: Transmit Clock (sourced from DCE)

XTC: Transmit clock (sourced from DTE)

a). E1/Datacom Tester as DTE

When the E1/Datacom tester is configured as a DTE, it can be connected to a DCE (normally a modem or some other data set) making it possible to test the whole datacom circuit from end to end. The DCE under test always supplies data (on RD) and clock (on RC) to the E1/Datacom tester.

Ø Tester Transmitter Supplies Clock to DCE under test

As shown in Fig 77, the E1/Datacom tester uses its internal synthesizer to clock out data (on TD) to DCE under test. It supplies a clock on XTC which should be used to clock this data into the DCE. The E1/Datacom tester does not use the clock on TC, if provided by the DCE under test.

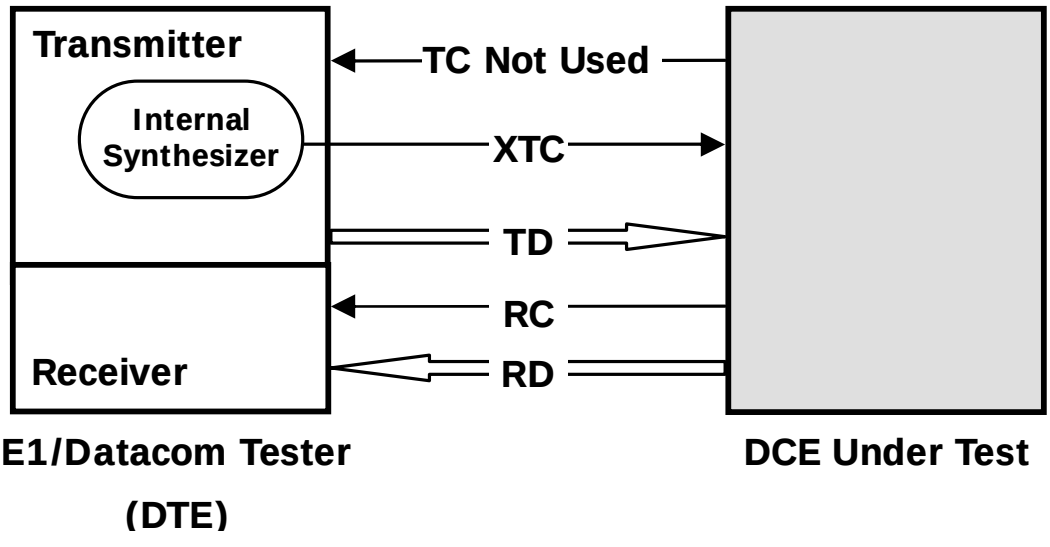

Fig 77: Tester supplies clock to DCE under test

Instrument settings: Datacom [DTE] [SYNC]
Tx Clock Source [INTERN]

Ø DCE Under Test Supplies Clock to Tester Transmitter

As shown in Fig 78, the E1/Datacom tester uses the clock supplied on TC to clock out data (on TD) to the DCE under test. A delayed version of this clock is sent back to the DCE on XTC.

With this configuration, there are two ways that the DCE can clock in data from the E1/Datacom tester:

- **ü The data is clocked into the DCE coincident with the clock it is supplying on TC. XTC is not used by the DCE. This approach is appropriate at lower data rates.**
- **ü The delayed clock on XTC is used to clock data into the DCE. This approach is more appropriate at higher data rate.**

Instrument settings: Datacom [DTE] [SYNC]
Tx Clock Source [RX CLK]

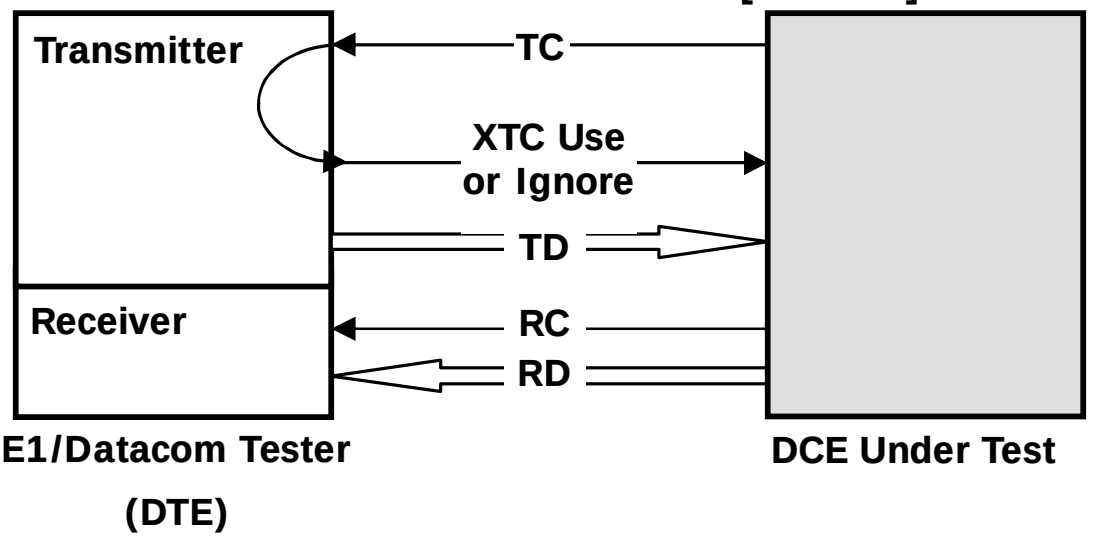

Fig 78: DCE under test supplies clock to tester transmitter

b）. E1/Datacom Tester as DCE

When the E1/Datacom tester is configured as a DCE, it can be connected to DTE equipments. Like a real data test set, the transmitter of tester supplies data (on RD) and clocks (on RC and TC) to the DTE under test. Both clock signals are derived from the same source.

Ø DTE Under Test Supplies Clock to Tester Receiver

As shown in Fig 79, the E1/Datacom tester uses the clock supplied on XTC to clock in data (on TD). The DTE under test may have generated this clock internally or may have derived from the clock supplied by the E1/Datacom tester (on TC).

The E1/Datacom tester uses its internal synthesizer to clock out data (on RD) and also to derive clock signals (on RC and TC).

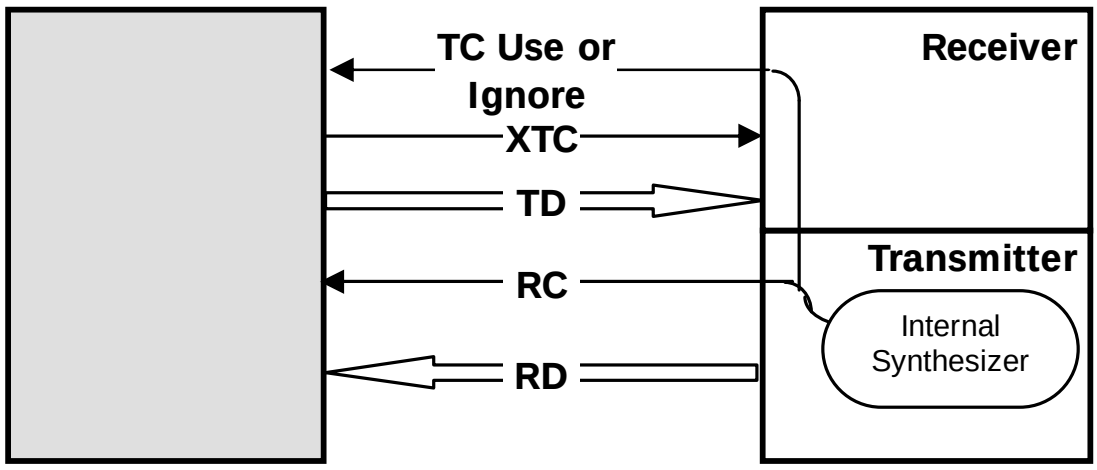

Fig 79: DTE under test supplies clock to tester

Instrument settings: Datacom [DCE] [SYNC]
Tx Clock Source [INTERN]

Rx Clock Source [RX CLK]

Ø Tester Transmitter Supplies Clock to Tester receiver

As shown in Fig 80, the E1/Datacom tester clocks in data (on TD) using the same clock that it supplies to the DTE under test (on TC). It follows that the DTE must use TC to clock out the data on TD. The tester does not use the clock on XTC, if provided by the DTE under test.

The E1/Datacom tester uses its internal synthesizer to clock out data (on RD) and also derive clock signals (on RC and TC).

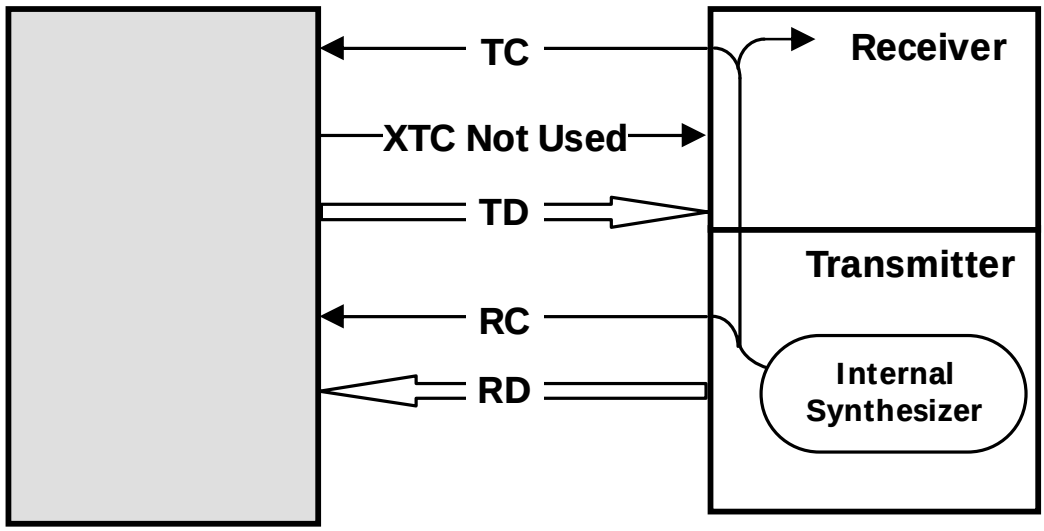

Fig 80: Tester transmitter supplies clock to tester receiver

Instrument settings: Datacom [DCE] [SYNC]
Tx Clock Source [INTERN]
Rx Clock Source [INTERN]

Ø DTE Under Test Supplies Clock to Tester Receiver and Transmitter

As shown in Fig 81, the E1/Datacom tester uses the clock supplied on XTC to clock in data (on TD). The DTE under test should have generated this clock internally.

The E1/Datacom tester uses the clock supplied on XTC to clock out data (on RD) and also to derive clock signals (on RC ans TC).

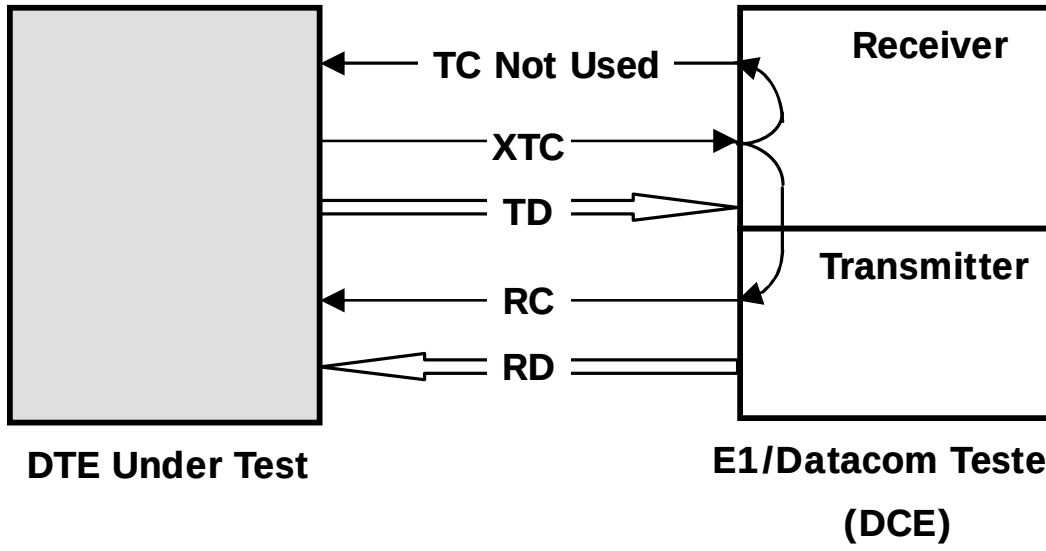

Fig 81: DTE under test supplies clock to tester transmitter and receiver

Instrument settings: Datacom [DCE] [SYNC]
Tx Clock Source [RX CLK]
Rx Clock Source [RX CLK]

c). Synchronous clock edge adjustment

The E1/Datacom tester provides clock valid edge adjustment function. Regardless DTE or DCE equipment, the data signals have strict phase relation with the clock signals. The data signals are always coincident with the clock signals to ensure that the valid edge of the clock (rising edge or falling edge) is

aligned to the middle of the data. This coincidence helps the equipment clock in or out the data properly. It is very important for user to configure the valid edge of sampling or transmitting the data. But various equipments from different vendors don't treat the clock edge in the same way. The valid edge of the clock signals is always uncertain to the user. Therefore, when making the synchronous measurements with the equipment under test, the user need to know the valid edge of clocks of the equipment under test firstly or try to adjust the valid edge of the clock when not sure about it .

If the instrument has no clock edge adjustment function, the test may be failed to the equipments from different vendors. The valid edge of transmit and receive clock signals is normally configured as the rising edge. The rising edge configuration may be effective for most digital equipments.

d). Handshaking Signal Testing

A typical datacom interface always has some control circuits for handshaking before the connection is established, for example "RTS/CTS" and "DTR/DSR". The E1/Datacom tester can monitor the status of these handshaking signals in real time. In "Settings" menu of a synchronous test, all the status of input handshaking signals can be displayed with "ON" or "OFF", and all the output handshaking signals of the control circuits can be set with ON or OFF.

"ON" status is defined as a "High" in logic and "OFF" is defined as a "Low" in logic. Since the logic "High" and "Low" stand for

the different level in voltage in deferent interfaces, please refer to "Technical Specification" chapter for details. The handshaking signal test function simplifies the troubleshooting of the establishment of data communication.

4.2.3 "G.703 CO" Service Testing

In either of transmit direction or receive direction of the G.703 co-directional interface, there have three kinds of signals, 64 kb/s (data signal), 64 kHz (timing signal) and 8 kHz (octet timing signal) passing through interfaces via a balanced cable. These three signals are integrated into one signal by coding. According to AMI coding rule, the receiver can recover the 64 kHz timing signal from the signal. By injecting one violation every 8 bit block (polarity conversion) in the transmission data, the receiver can recognize 8 kHz octet timing signal. For full duplex communication, the interface needs only two pairs of balanced circuits.

Digital equipments with 64 kb/s co-directional interfaces such as data terminals, packet switch and router can be directly connected with digital transmission equipment (PCM equipment). For example, two routers are connected with 64 kb/s co-directional interface through the transmission system.

The 64 kb/s co-directional interface can be tested in following ways:

- Far-end interface loopback: Connect a loopback to the far-end equipment interface. At the far-end equipment, the transmit signals is looped back into the receiver. Fig

82 shows the typical connection.

- Local loop or far-end network equipment loopback: Connect a loopback to the near-end or far-end network equipment. These equipments are used to transmit signals in the path, such as PCM, SDH equipment. Fig 83 shows the typical connection.
- Far-end mutual test: Two E1/Datacom testers are respectively placed at the near end and the far end to make BER testing to 64 kb/s co-directional path directly. Fig 84 shows the typical connection.

Note:

Since some equipments have the software remote control function, in a loopback test, the loopback can be formed between equipment interfaces via the loopback cable or formed by software loopback configuration.

Following parameters of the instrument need to be set before testing, including "BERT pattern", "Polarity", "Tx clock source", "Octet timing", "Error add", "Resolution", "Storage" and "Duration". Please refer to Section 3.2.3 for details.

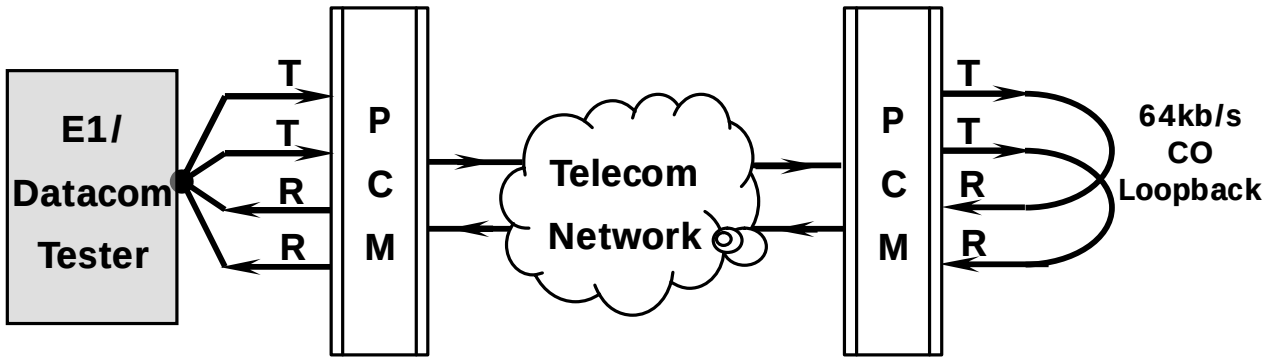

Fig 82: Far-end interface loopback

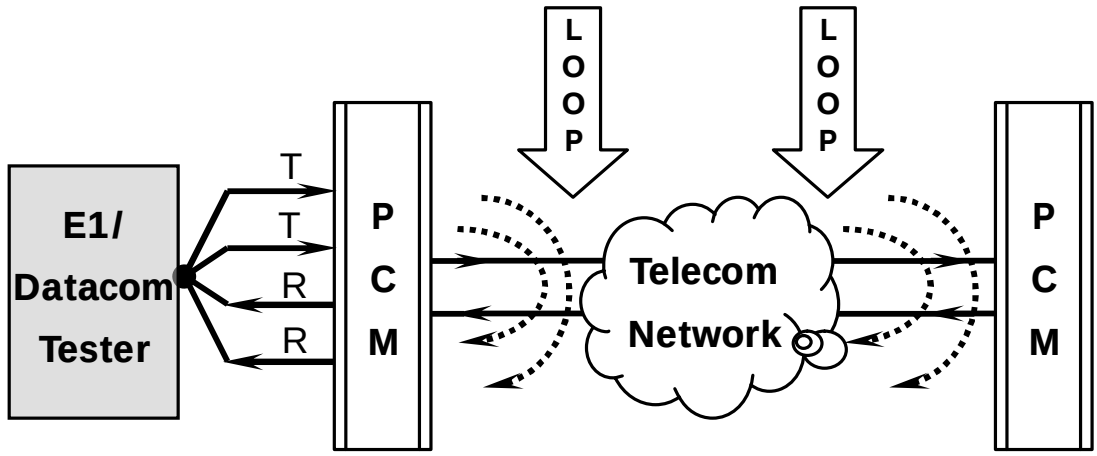

Fig 83: Local loop or far-end network equipment loopback

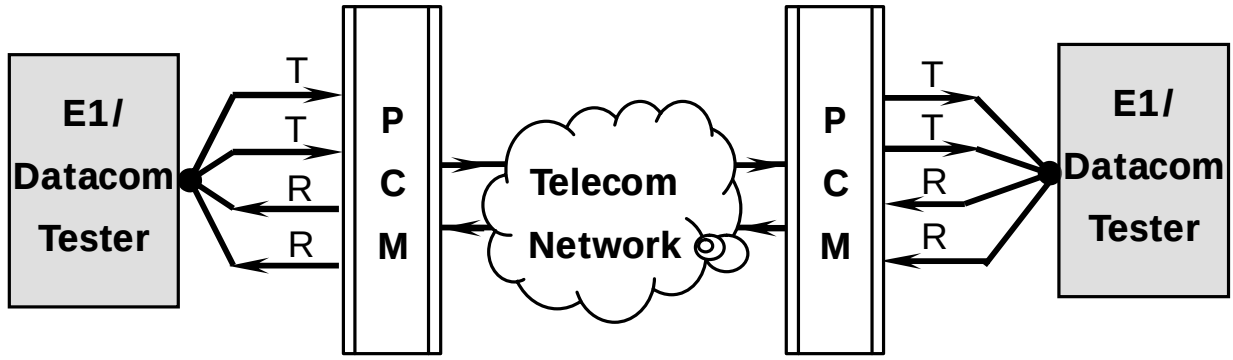

Fig 84: Far-end mutual test

Throughout the test process, bit error can be directly inserted into the path via the "Single Err Add" key of the instrument to verify the operating status of the instrument and signals transmitted and received in the path.

Note:

Throughout the test process, the OCTET timing needs to be enabled to ensure the right transmission of data through the 64 kb/s co-directional interface.

Test Description:

Results throughout the test period can be acquired from the test result menu, including Basic Analysis (Error, EFS, Current error ratio, Average error ratio, block errors, errored block ratio), Alarm Seconds (Signal loss, Clock loss, Pattern loss, Clock slip, Octet loss), G.821 Analysis, Signal Analysis (Line rate, Frequency offset), Event Records, etc.

4.2.4 "Protocol Converter" testing

"Protocol Converter" is also named as "Mux/DeMux" in other instrument. The protocol converters are widely used in applications to interconnect various protocol data interfaces nowadays. Most commonly used protocol converters include E1-V.35, E1-V.24 and E1-G.703 CO, are mainly used to meet the needs of interconnections and network optimization between network routers and traditional communication network. Since E1 path supports both framed and unframed transmission, so a converter is frequently used to adapt the low speed synchronous Nx64k data to timeslots of the framed E1 for transmission. Through the DXC equipment, the adapted data timeslots were combined with together into one E1 path to be transmitted, and the transmission bandwidth is efficiently used and resources are saved.

In the past, the transmission performance of the protocol converters could only be evaluated by the loopback one protocol interface, and measured at the other interface. This test mode will be supported by selecting "Function" item of

the instrument as "E1", "Datacom" and "G.703 CO". But if there is something wrong with the measurements, user can not identify which direction the problem happens in, the receive direction or the transmit direction. The E1/Datacom tester provides a one-direction test mode to transmit and receive data with various data interfaces, thus can accurately determine the problem happens to the transmit direction or the receive direction, providing effective help for the maintenance and troubleshooting.

The E1/Datacom tester supports synchronous error bit rate test function between E1 and V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A, G.703 CO interfaces. It applies to the transmission performance test for multiple protocol converters and the development, manufacturing, installation, certification and maintenance test of protocol converters.

Most commercially available data protocol converters today are provided as a DCE, so special attention should be paid to the synchronous clock configurations. The examples shown below apply to all the test modes, only the E1-V.35 and E1-G.703 protocol converters are used.

4.2.4.1 E1-Datacom Synchronous BER Testing

a. Transmitter is "E1", Receiver is "Datacom" "DTE"

Ø Tester Supplies Clock to Converter Under Test

The E1/Datacom tester uses its internal synthesizer to clock out data (on E1) to the converter. The converter uses the clock which is derived from received E1 signal and then

divided to clock out data (on RD) and supplies clock (on SCR) to the instrument. In this way, the clock source of protocol converter should be configured as "E1 Line clock". Thus, the clock of the converter under test is sourced from the instrument actually, as shown in Fig 85.

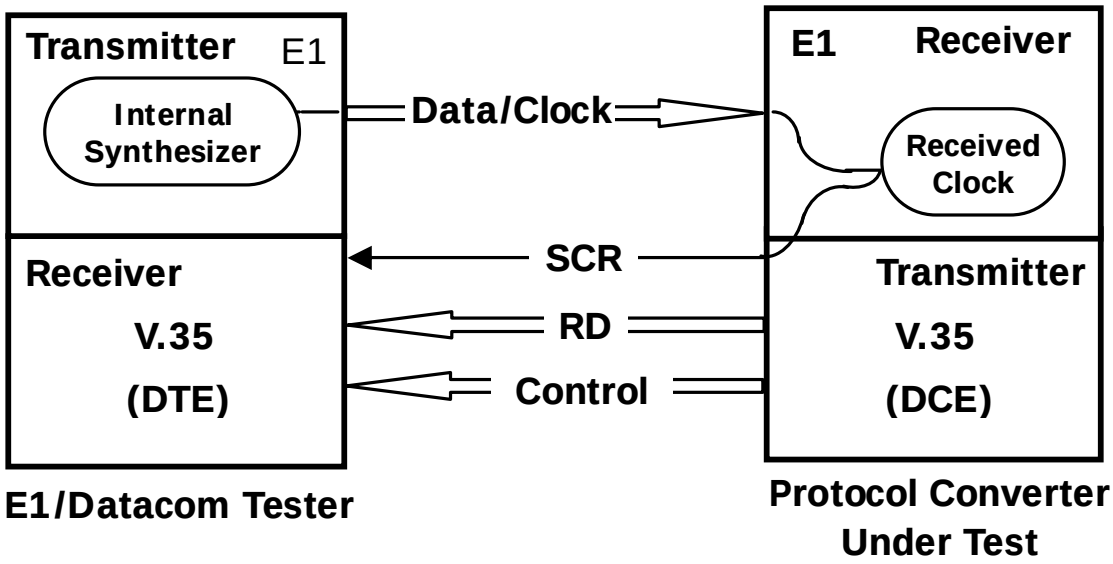

Fig 85: Tester supplies clock to protocol converter under test

Ø **Tester Supplies Clock to Converter Under Test**

The E1/Datacom tester uses its internal synthesizer to clock out data (on E1) to the converter. The converter uses the clock which is derived from received E1 signal and then divided to clock out data (on RD) and supplies clock (on SCR) to the instrument. In this way, the clock source of protocol converter should be configured as "E1 Line clock". Thus, the clock of the converter under test is sourced from the instrument actually, as shown in Fig 85.

Instrument settings:

Tx interface: [E1] E1 Tx clock source <Internal>

Rx interface: [V.35] [DTE] V.35 Rx clock: <RX CLK>

Protocol converter settings:

Rx interface: E1 Tx interface: V.35 DCE

Tx clock source: E1 Line clock

Note:

If the protocol converter is unable to provide clock valid edge choice, the valid clock edge of the instrument may be set as " ". Because under such circumstance, the protocol converter usually clocks out data in coincidence with the rising edge of clock, and the falling edge is aligned to the middle of the data.

Ø Converter Uses Internal Clock

The protocol converter uses its internal synthesizer to clock data (on RD) and supplies a clock (on SCR) to the instrument. In this mode, both the instrument and the converter under test work with its internal clock themselves. There is no common clock source, as shown in Fig 86.

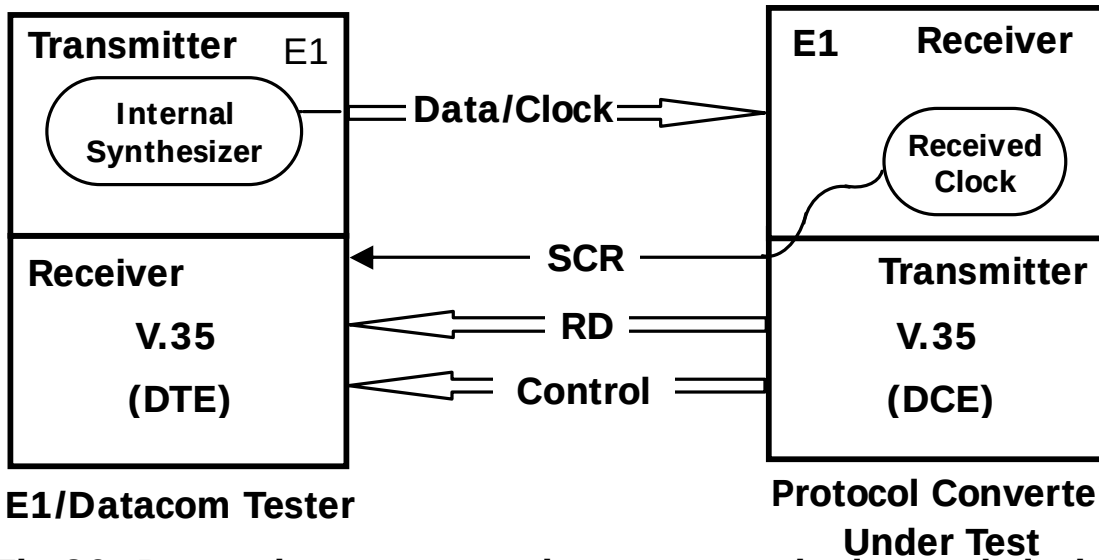

Fig 86: Protocol converter under test uses the internal clock

Instrument settings:

Tx interface: [E1] E1 Tx clock source <Internal>

Rx interface: [V.35] [DTE] V.35 Rx clock: <RX CLK>

Protocol converter settings:

Rx interface: E1 Tx interface: V.35 DCE

Tx clock source: Internal

b. Transmitter is "E1", Receiver is "Datacom" "DCE"

Ø Tester Supplies Clock to Converter Under Test

Same with the receiver is "Datacom" "DTE", as shown in Fig 85. At this time, the protocol converter is emulated as a DTE.

Instrument settings:

Tx interface: [E1] E1 Tx clock source <Internal>

Rx interface: [V.35] [DCE] V.35 Rx clock: [RX CLK]

Protocol converter settings:

Rx interface: E1 Tx interface: V.35 DTE

Tx clock source: E1 Line clock

When the clock source of the V.35 receiver is chosen as "Internal", the instrument uses the clock (on SCT) which is supplied to the transmitter of converter under test to clock in the data (on SD). At this time, the protocol converter must use SCT to clock out data on SD. The instrument does not use the clock on SCR, if provided by the protocol converter under test. The instrument uses its internal synthesizer to derive the clock on SCT, shown in Fig 87.

Instrument settings:

Tx interface: [E1] E1 Tx clock source <Internal>

Rx interface: [V.35] [DCE] V.35 Rx clock: [Internal]

Protocol converter settings:

Rx interface: E1 Tx interface: V.35 DTE

Tx clock source: E1 Line clock

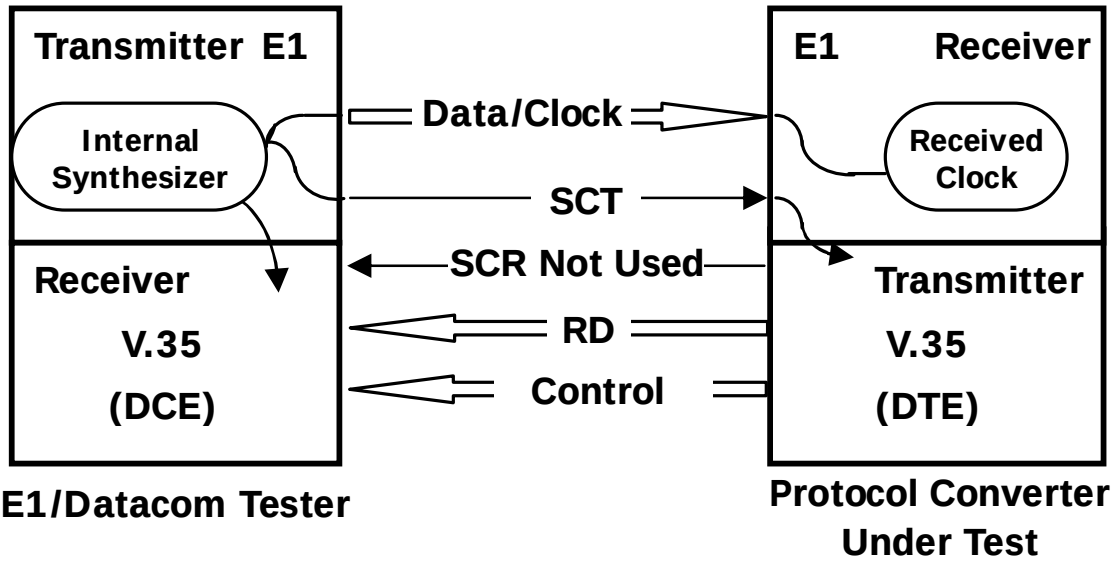

Fig 87: Tester supplies clock to the transmitter of converter

Ø Converter Uses Internal Clock

Same with the receiver is "Datacom" "DTE", as shown in Fig 86. At this time, the protocol converter uses its internal synthesizer to receive E1 data and clock out V.35 data on RD. And the Rx clock source of the instrument should be fixed on "Interface".

Instrument settings:

Tx interface: [E1] E1 Tx clock source <Internal>

Rx interface: [V.35] [DCE] V.35 Rx clock: [RX CLK]

Protocol converter settings:

Rx interface: E1 Tx interface: V.35 DTE

Tx clock source: Internal

c. Transmitter is "Datacom" "DTE", Receiver is "E1"

The instrument uses its internal synthesizer to clock data (on SD). And the protocol converter must use the clock on SCR to generate 2M clock to transmit E1 signal. At this time, the protocol converter should be configured in "EXT line clock" mode which means clock is sourced from the datacom interface, as shown in Fig 88.

Instrument settings:
Tx interface: [V.35] [DCE] V.35 Tx clock: <Internal>
Rx interface: [E1] E1 Rx clock source <Interface>
Protocol converter settings:
Rx interface: V.35 DTE Tx interface: E1
Tx clock source: EXT line clock (on V.35)

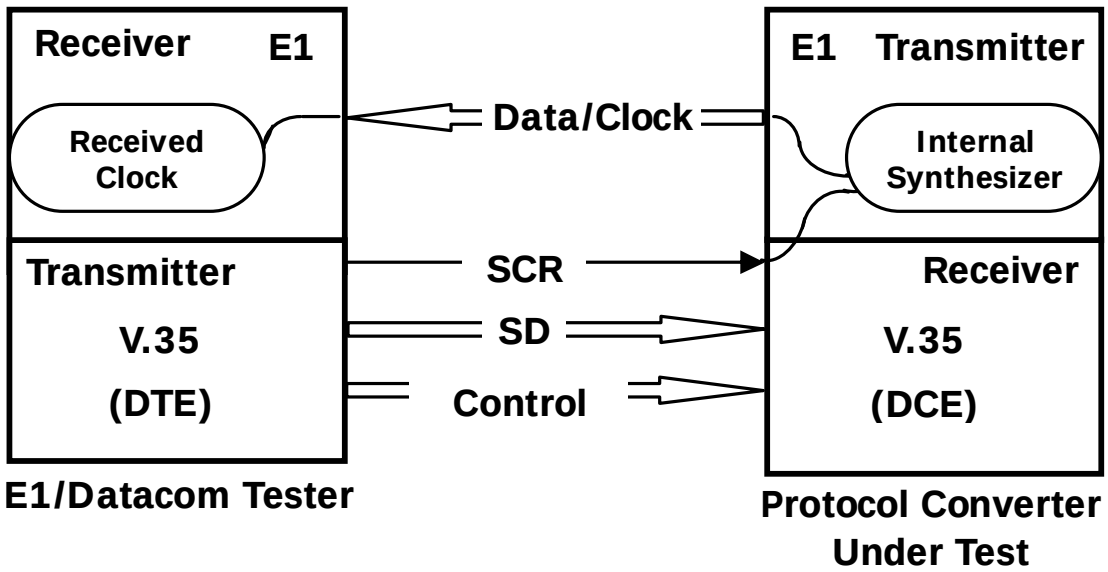

Fig 88: Tester supplies clock to converter under test

d. Transmitter is "Datacom" "DCE", Receiver is "E1"

It is fully same with the case when the transmitter of instrument is "V.35" "DTE" and the receiver is "E1". If the protocol converter supports receiving clock signal SCT from DCE equipment, then the protocol converter can use the clock on SCT as "EXT line clock" to transmit data on RD, otherwise the clock on SCR should be used.

Test Description

- **Choose "Protocol Converter" in the "Settings" menu, make the configurations to all the parameters. Refer to Section 3.2.4 for details.**
- **Press the "Start/Stop" key when settings have been configured, and press the "Result" key to enter into relevant result menu. See relevant descriptions in Section 3.3.4 for details.**
- **Be sure that the transmit interface, the receive interface, emulation and clock mode should be configured properly with the protocol converter under test.**
- **Throughout the test process, bit error can be directly inserted into the path via the "Single Err Add" key of the instrument to verify the operating status of the instrument and signals transmitted and received in the path.**

4.2.4.2 E1-G.703 CO Synchronous BER Testing

Since both G.703 co-directional and E1 interface are extracted the clock from the received signal, so the clock configuration is simple, with specific description as follows.

a. Transmitter is "E1" , Receiver is "G.703 CO"

The E1/Datacom tester uses its internal synthesizer to transmit E1 signals. And the protocol converter uses the clock derived from the received E1 signal to transmit G.703 co-directional signal. The instrument uses the clock derived from received signal to clock in data at the G.703 CO interface, as shown in Fig 89.

Instrument settings:

Tx interface: [E1] E1 Tx clock: <Internal>

Rx interface: [G.703 CO] Rx clock source <Interface>

Protocol converter settings:

Rx interface: E1 Tx interface: G.703 CO

Tx clock source: E1 Line clock

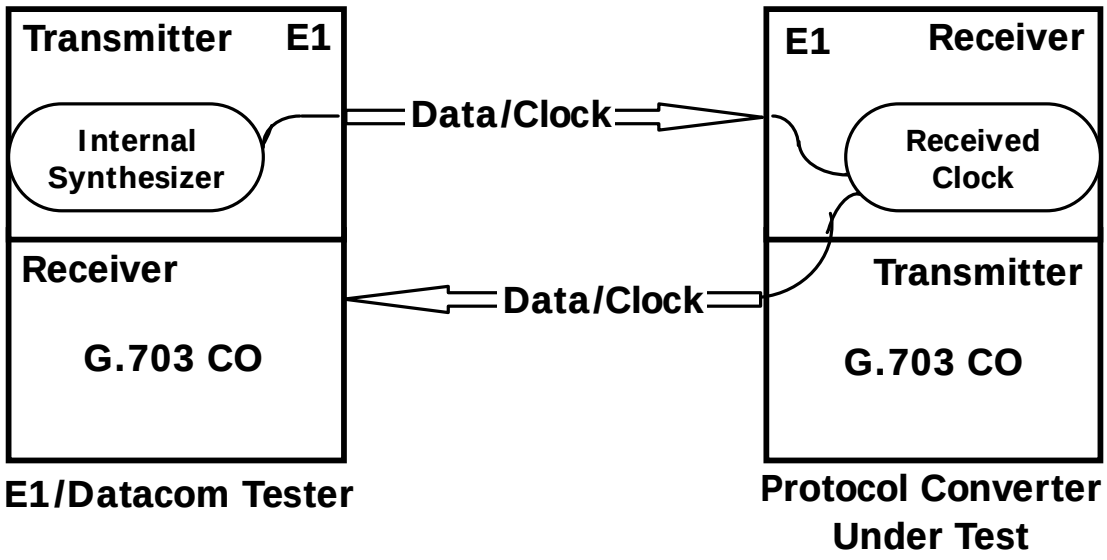

Fig 89: Transmitter is "E1" and Receiver is "G.703 CO"

b. Transmitter is "G.703 CO" , Receiver is "E1"

The E1/Datacom tester uses its internal synthesizer to transmit G.703 co-directional signal. The protocol converter uses the clock derived from the G.703 CO interface to generate

the clock to transmit E1 signal, as shown in Fig 90.

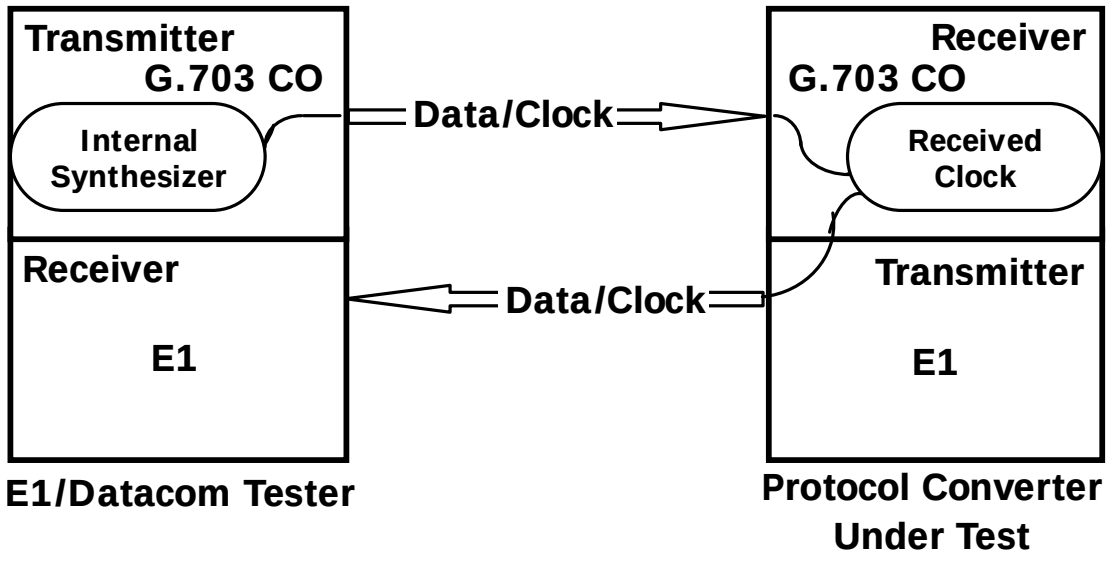

Fig 90: Transmitter is "G.703 CO" and Receiver is "E1"

Instrument settings:

Tx interface: [G.703 CO] G.703 CO Tx clock: <Internal>

Rx interface: [E1] Rx clock source: <Interface>

Protocol converter settings:

Rx interface: G.703 CO Tx interface: E1

Tx clock source: EXT line clock (on G.703 CO)

Test Description

- Choose "Protocol Converter" in the "Settings" menu, make the configurations to all the parameters. Refer to Section 3.2.4 for details.
- Press the "Start/Stop" key when settings have been configured, and press the "Result" key to enter into relevant result menu. See relevant descriptions in Section 3.3.4 for details.
- Be sure that the transmit interface, the receive interface, emulation and clock mode should be configured properly

with the protocol converter under test.

- **Throughout the test process, bit error can be directly inserted into the path via the "Single Err Add" key of the instrument to verify the operating status of the instrument and signals transmitted and received in the path.**

5 Technical Specifications

This chapter introduces the technical specifications of all the interfaces in the E1/Datacom tester.

5.1. "E1" Specifications

5.2. "G.703 CO" Specifications

5.3. "Datacom" Specifications

5.4. "Protocol Converter" Specifications

5.5. Other Specifications

5.1. "E1" Specifications

5.1.1 General

Measuring interface	**2048Kb/s**
Alarm LEDs	**Signal Loss**
	AIS
	Frame Loss
	MFrame Loss (CAS and CRC)
	Remote Alarm (RDI and Remote MF)
	Pattern Loss
	Errors
	Clock Slip
Alarm Hierarch	**The more important alarm will suppress a lesser alarm, see below.**

Hierarch	Alarm and Error		
1	Signal Loss		
2	AIS	Errors	
3	Frame Loss	CAS MF Loss	CRC MF Loss
4	Pattern Loss	Remote Alarm	Remote MF Alarm

E1 standards

- **Comply with G.703, G.706, G.732**
- **PCM30: G.704 with CAS multiframe**
- **PCM31: G.704 with no multiframe**
- **PCM30CRC: G.704 with CAS and CRC4 multiframe**
- **PCM31CRC: G.704 with CRC4 multiframe**

Test Pattern

- **PRBS: 2^{23}-1(O.151), 2^{15}-1(O.151)**
  2^{11}-1(O.153), 2^{9}-1
- **Fixed Code: 1111, 0000, 1010**
- **16BIT: Fully programmable 16-bit word**
- **PRBS Polarity: "Normal" or "Inverted"**

Test Period	**Manual, Auto, Timer**
Result Analysis	**G.821, G.826, M.2100 Analysis**

5.1.2 Transmitter

Line Code	**HDB3, AMI**
Impedance	**75Ω unbalanced, 120Ω balanced**
Pulse Shape	**Conforms to ITU-T G.703 Table 6**
Jitter	**Meets ITU-T G.823 Section 2**
Tx Clock Source	**Internal, Interface, External source**

Internal Tx Clock

- **Frequency: 2.048 MHz**
- **Stability: ±10 ppm temperature 0~40℃**
- **Ageing: ±2 ppm per year (typical)**
- **Deviation: ±999 ppm**

External Tx Clock	**2.048 MHz ± 200 ppm binary clock or 2 Mbit/s HDB3 signal**

Error Add	**BIT, CODE, FAS, CRC4, E-BIT**
Error Add Rate	**Single, 1E-N, N=2~7**

5.1.3 Receiver

Rate	**2.048 Mbit/s ± 999 ppm**
	(G.703 specs ±50 ppm)
Line Code	**HDB3, AMI**
Pulse Shape	**Conforms to ITU-T G.703 Table 6**
Jitter Tolerance	**Meets ITU-T G.823 Section 3**

Impedance

- **"TX/RX": 75Ω unbalanced, 120Ω balanced**
- **"RX HI-Z": >2KΩ unbalanced, balanced**
- **"Through": 75Ω unbalanced, 120Ω balanced**

Receive Sensitivity **> -43dB**

External Clock Input

- **Binary Clock Input: 2.048 MHz, Square ware, TTL**
- **2M bit/s Signal Input: HDB3, 75Ω unbalanced**

Timeslot Analysis

- **FAS / NFAS**
- **MF0TS16**
- **Timeslot data**
- **Timeslot activity**
- **VF tone frequency and level measurement**

VF Tone Measurement

- **Frequency Measurement: 200Hz ~ 3400Hz**
- **Frequency Accuracy: ± 1Hz**
- **Level Measurement: -60 dB ~ +3.14 dB**
- **Level Accuracy:**

	-60 dB ～ -21 dB: ± 2.87 dB
	-20 dB ～+3.14 dB: ±0.21 dB
Delay Measurement	Accuracy: ± 1 μs

5.2. "G.703 CO" Specifications

5.2.1 General

Measuring Interface	G.703 co-directional
Standard	G.703
Line Code	AMI
Test Pattern	Same as "E1"
Test Period	Manual, Auto, Timer
Result Analysis	G.821 Analysis
Physical Interface	DB44 (G.703 CO test cable)
Pin Assignments	See Appendix C

5.2.2 Transmitter

Impedance	120Ω balanced (Nominal)
Pulse Shape	Conform to with ITU-T G.703 Table 1
Tx Clock Source	Internal, Interface (Loop timing)

Internal Tx Clock

- Frequency: 64 kHz
- Stability: ± 30 ppm temperature 0~40℃
- Ageing: ±2 ppm per year (typical)

Octet Timing	Comply with ITU-T G.703, can be disabled.
Error Add	Same as "E1"

5.2.3 Receiver

Rate	64 kbit/s ± 150 ppm

	(G.703 specs ± 100 ppm)
Input Impedance	120Ω balanced (Nominal)
Pulse Shape	Conforms to ITU-T G.703 Table 1
Interference	Typically meets G.703
Jitter Tolerance	Meets ITU-T G.823 Section 3
Alarm Detection	Signal Loss
	Octet Loss

5.3. "Datacom" Specifications

5.3.1 General

Measuring interface	V.24, V.35, V.36, X.21, RS-449, RS-485, EIA-530, EIA-530A

a. V.24

General	Equivalent to RS-232/V.28
	DB25 connector
	DB44-DB25 adapter cable
	Maximum data rate 128Kb/s
Drivers	Output voltage (into 3kΩ to 73kΩ):
	-15V ~ -5V: Binary 1 / Mark / OFF
	+5V ~+15V: Binary 0 / Space / ON
	Slew rate 30V/μs maximum.
	Short circuit current less than 100mA
Receiver	Input voltage:
	3V min: Binary 0 / Space / ON
	0.8V max: Binary 1 / Mark / OFF
	Input impedance: 3kΩ to 7kΩ

Pin Assignments See Appendix B

b. V.35

General	**M34 connector** **DB44-M34 adapter cable** **Data and clock circuits are balanced according to V.35** **Balanced signal polarity:** **A＜B: Binary 1 / OFF** **A＞B: Binary 0 / ON** **Control circuits are unbalanced according to V.28**
V.35 Drivers	**Terminal-to-terminal voltage:** **± 0.44V ~ ± 0.66V** **Source impedance: 50Ω~150Ω** **Resistance between shorted terminals and ground: 150Ω±10%** **Rise time less than 40ns** **DC signal offset less than ±0.6V**
V.35 Receivers	**Input impedance: 100Ω±10%** **Resistance between shorted terminals and ground: 150Ω±10%**
V.28 Drivers	**Output voltage (into 3kΩ to 7kΩ):** **-15V ~ -5V: Binary 1 / OFF** **+5V ~+15V: Binary 0 / ON** **Slew rate 30V/μs maximum** **Short circuit current less than 100mA**

V.28 Receiver Input voltage:
3V min: Binary 1 / OFF
0.8V max: Binary 0 / ON

Pin Assignments See Annex B

c. V.36

General DB37 connector
DB44-DB37 adapter cable
Data and clock circuits are balanced according to V.11, control circuit conforms to V.10
Input clock and data signal terminated by 120Ω
Balanced signal polarity:
A＜B: Binary 1 / OFF
A＞B: Binary 0 / ON

V.11 Driver Differential output voltage:
±2V minimum into 100Ω
±5V maximum Open circuit
Rise time less than 20ns
Short circuit current less than ±150mA

V.11 Receiver Differential input threshold voltage: ±0.3V
Input impedance: 4kΩ minimum

V.10 Drivers Open circuit voltage: ±4V~±6V
±3.6V minimum into 450Ω
Short circuit current less than ±150mA

V.10 Receiver	Input current: -3.25mA~+3.25mA
	Input impedance: 4KΩ minimum
	Differential input threshold voltage: ±0.3V

Pin Assignments See Appendix B

d. X.21

General	DB15 connector
	DB44-DB15 adapter cable
	Data and clock circuits are balanced according to V.11
	Input clock and data signal terminated by 120Ω

Pin Assignments See Appendix B

e. RS-449

General	DB37 connector
	DB44-DB37 adapter cable
	Data and clock circuits are balanced according to V.11 and V.10
	Input clock and data signal terminated by 120Ω

Pin Assignments See Appendix B

f. RS-485

General	DB25 connector
	DB44-DB25 adapter cable
	Data and clock circuits are balanced

according to V.11 and V.10
Input clock and data signal terminated by 120Ω

Pin Assignments See Appendix B

g. EIA-530

General DB25 connector
DB44-DB25 adapter cable
Data and clock circuits are balanced according to V.11 and V.10
Input clock and data signal terminated by 120Ω

Pin Assignments See Appendix B

h. EIA-530A

General DB25 connector
DB44-DB25 adapter cable
Data and clock circuits are balanced according to V.11 and V.10
Input clock and data signal terminated by 120Ω

Pin Assignments See Appendix B

i. Terminal Emulation DTE or DCE

j. Test Pattern

- PRBS: 2^{20}-1(O.153), 2^{15}-1(O.151)
  2^{11}-1(O.153), 2^{9}-1(O.153), 2^{6}-1

- Fixed Code: 1111, 0000, 1010
- 16BIT: Fully programmable 16-bit word
- PRBS Polarity: "Normal" or "Inverted"

k. Result Analysis G.821 Analysis

5.3.2 Transmitter

Ø Synchronous Mode

General	Provided for all datacom interfaces
Clock Source	Internal synthesizer Datacom interface. May be inverted, Allowing selectable clock/data phase relationship X.21 operation limited as follows: DTE: datacom interface DCE: internal
Synthesizer Rates	1.2 Kb/s, 2.4 Kb/s, 4.8 Kb/s, 7.2 Kb/s 9.6 Kb/s, 19.2 Kb/s, 38.4 Kb/s, N×64 Kb/s (N=1~32)
Synthesizer Accuracy	±30 ppm Ageing ±2 ppm per year typical
Interface Clock Source	Minimum rate: 50 bit/s Maximum rate: 2.048 Mb/s
Clock Output	Datacom interface. May be inverted, allowing selectable clock/data phase relationship. No clock output on X.21 interface when

configured as DTE.

Ø Asynchronous Mode

General Not provided for X.21 operation.

Rates 50 b/s, 75 b/s, 150 b/s, 300 b/s, 600 b/s, 1.2K b/s, 2.4 Kb/s, 4.8 Kb/s, 7.2 Kb/s, 9.6 Kb/s, 19.2 Kb/s.

Character Format

- Character length: 5, 6, 7 or 8 bits.
- Parity: odd, even, 0, 1 or none.
- Stop bits: 1 or 2 (character length 6, 7 or 8 bits); 1.5 (character length 5 bits).

Data Polarity Normal or inverse polarity may be selected.

Error Add Same as "E1". (Bit error only)

5.3.3 Receiver

Ø Synchronous Mode

Rates Maximum rate 2.048 Mbit/s

Clock Sources Datacom interface.
Internal (DCE mode only).
Data is clocked coincident with the transmitter output clock.
Both sources may be inverted, allowing selectable clock/data phase relationship.
X.21 operation limited as follows:
DTE: datacom interface.
DCE: internal.

Ø Asynchronous Mode

General Not provided for X.21 operation.

Rates	As selected for transmitter.
Character Format	As selected for transmitter.
Data Polarity	Normal or inverse polarity may be selected.

5.4. "Protocol Converter" Specifications

Refer to the parameters in "E1" and "Datacom".

5.5. Other Specifications

Serial Port	RS-232
	Baud Rate: 19.2 Kb/s
	Character Length: 8 bit
	Parity: None
	Stop Bits: 1 bit
Battery	5×1.2V AA NiMH rechargeable battery,
	GP180AAHC, 1800 mAH
AC Power Adapter	Input: AC 100V~240V ±10%
	50/60 Hz 0.45A
	Output: DC12V/1.5A
Dimension	249mm×90/128mm×60mm (L×W×H)
Weight	760g
Operating Temperature	0~40℃
Storage Temperature	-30~+70℃
Humidity	5%~90% no condensation

6 Working with TestManager

This chapter briefly describes the software functions, system configurations and running environment, install and uninstall the software on the PC and how to use TestManager software.

6.1 Software Functions
6.2 System Configuration and Running Environment
6.3 Install and Uninstall the Software on the PC
6.4 How to Use TestManager Software

6.1. Software Functions

TestManager communicates with the XG-series tester via the serial port in PC. It can support uploading the stored data from the tester, viewing and printing the stored results. You can easily check, manage and analyze every test result on your PC. It also can describe all the error and alarm events happened in the test period time in detail by "square drawing" and help you in classification, filing and report outputting of the test results. Another very important function of TestManager is that you can on-line upgrade the embedded software in the tester with this PC software.

Basic functions of TestManager:

- **Select the type of the instrument**
- **Connect the instrument**
- **Upload the test results which stored in the instrument**
- **View the stored results**
- **Analyze the stored results**
- **Clean up the records uploaded**

- Plot out the test results with the graphics, table or text mode
- Upgrade the embedded software
- Help

6.2. System Configuration and Running Environment

6.2.1 Firmware

Basic configurations required:

- PC: 586/133MHz or better
- Memory: above 16MB
- Hard disk: above 50MB
- CD-ROM drive for installation
- Standard mouse and keyboard
- Serial port
- Windows-compatible printer or plotter

6.2.2 Operating System

- Windows ME/2000/NT/XP

6.2.3 System Configuration Recommendation

- System display mode: 800x600 Pixels
- Install the printer or plotter before setup

6.3. Install and Uninstall the Software on the PC

6.3.1 Installation Process

- Close all programs and turn off virus protection software to prevent installation confliction.
- Open the package and carry out the data CD with the mark of "TestManager";

- Insert the CD into the CD-ROM drive;
- View the contents of the CD from "My Computer";
- Double-click "Setup.exe";
- Complete the installation according the setup wizard;
- After completing installation of the software, one short-cut icon "TestManager" will be placed on the desktop automatically;
- Double-click the icon "TestManager" to run the program.

Note:

We strongly recommend that user installs the software following the default mode.

6.3.2 Uninstall TestManager

- From the "Start" menu, choose "Settings";
- Open "Control Panel";
- Click "Add/Remove Programs";
- Select "TestManager" in the list;
- Click "Change/Remove" button to remove the software automatically.

6.4. How to Use TestManager Software

6.4.1 Connect the Instrument

See Section 2.4, and confirm connection successful and setting correct.

6.4.2 TestManager Software Operation

Graphic windows help the user operate TestManager software

simply and easily. User can work with TestManager as follows.

- Double-click the icon of "TestManager" to run the software.
- Switch off the instrument.
- Connect RS232 communication cable between the integrated RS232 port with the serial port of your PC.
- Switch on the instrument and set RS232 "Port State" as "ON".
- Click "Select" icon in the short-cut bar or in the "Manipulation" menu to choose the type of instrument which you are working with.
- Click "Connect" icon in the short-cut bar or in the "System" menu to make the connection with the instrument.
- After connecting successfully, user can do the operations as below.
  - Ü Upload the stored results:
    Click "Upload" icon in the short-cut bar or in the "Manipulation" menu to upload the stored results from the instrument.
  - Ü View the uploaded results:
    Click "View" icon in the short-cut bar or in the "Manipulation" menu to check the detailed information of every uploaded results in the software. If there has a graph result, user can also view the histogram analysis of the error and alarm events. In addition, user can delete and print any result.

- **Clean up all uploaded results in software:**
  Click "Clean Up the Records" the "System" menu to delete all the uploaded results of one instrument in the list.
- **Upgrade the embedded software:**
  Click "Upgrade embedded software" the "System" menu to update the embedded software of the selected instrument.
  First step: Click "Read" button to read out the type and software version of the selected instrument.
  Second step: Click "Load File" button to load the target hex file into the program.
  Third step: Click "Next" button to enter into the upgrading window and then click "Upgrade" button to start upgrading.
  Fourth step: The program will automatically complete the upgrading process. After being upgraded, the instrument will reset itself.
  Fifth step: Switch off the instrument and uninstall the RS232 communication cable. Close "TestManager" program.

7 Troubleshooting

This chapter is intended to provide prompt help to operator on some frequently asked questions and the resolutions.

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1. The tester cannot be powered on or has no displays.

When "Low Battery" alarms, the tester will be shut down soon automatically. When the voltage of battery drops to a low level, the power circuit of the tester will be locked and cannot be opened until:

- **ü Plug the AC power adapter into an appropriate AC wall outlet and power the tester with external power supply.**
- **ü When the battery is fully charged, unplug the AC power adapter and press the "Power" key to switch on the tester. And the tester will work normally.**

2. When the battery charged fully, "Charge" LED will be turned off. And LED will be lit as soon as plugging AC adapter again.

This is normal. The battery will be charged automatically when connected with AC power adapter because the power consumption in working process. The battery will be fully charged in a very short time. And "Charge" indicator will turned off.

3. The tester shuts off.

- **ü Check if the voltage of battery is low.**
- **ü Check if "Auto power off" in "Power Manager" of "Other" menu is set to ON or not.**

4. The tester cannot work with battery.

Switch off the tester. Open the end cover of tester, check if the battery case is locked tightly or not. If not, re-clip the case and slide it back on emphatically. When hearing "Click", the battery case has been installed into the provided slot successfully. Then install the end cover back.

5. Duration of battery is getting shorter.

The usage life time of new rechargeable battery is about 800~1000 cycles of charge and discharge. When you find the working duration is reduced in evidence, you should replace the rechargeable batteries. Do not put the old and new batteries in use together or use some bad or unconfirmed rechargeable batteries.

6. Get more help

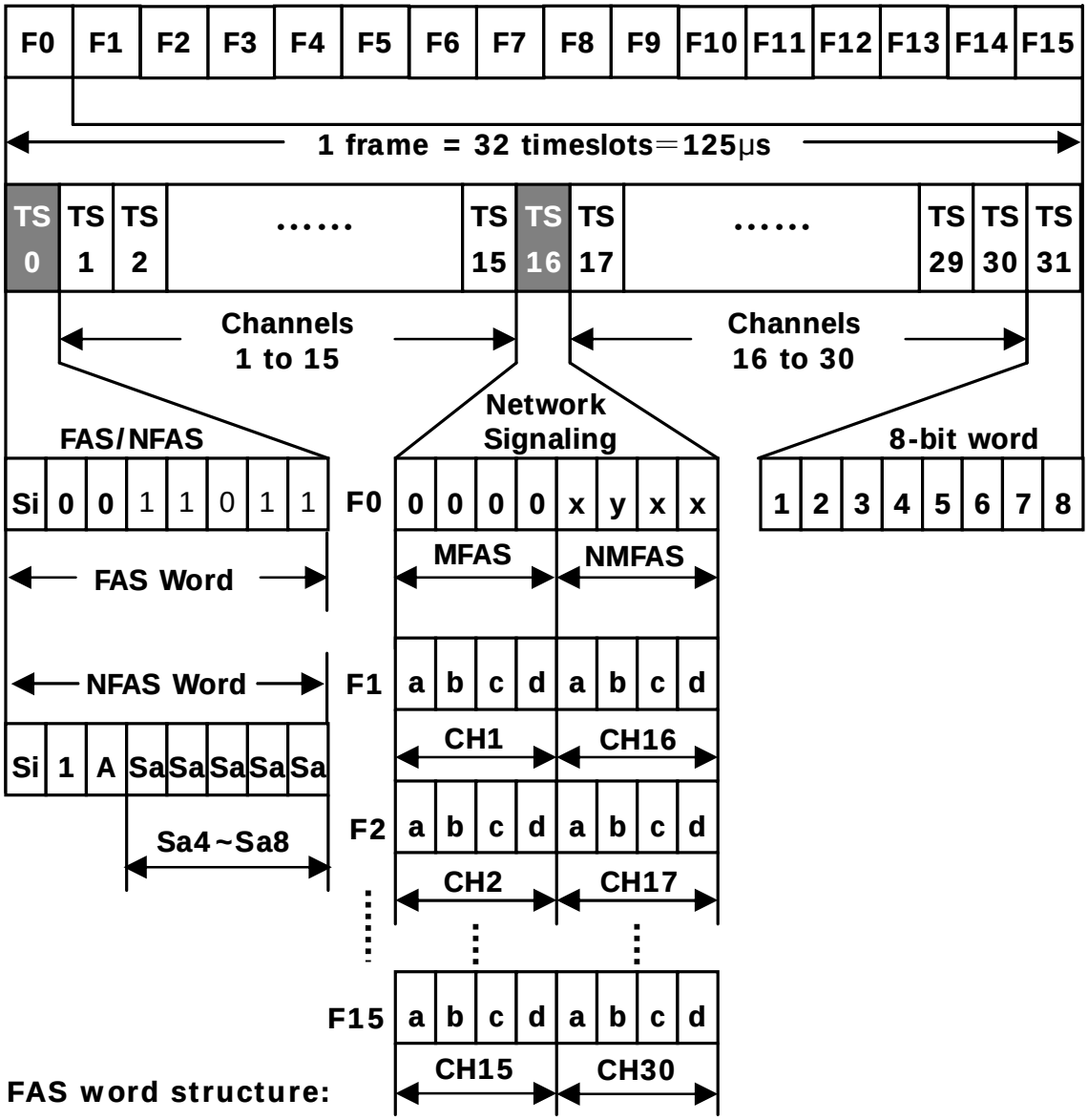
If you have any other questions, please contact with the manufacturer by phone or by emails as soon as possible.

If you find that theinstrument can not work, please contact your provider as soon as possible. Do not open the instrument by yourself.

If the frangible pastes around the tester are damaged or have been removed, user would lose the 1-year free-maintenance service.

Appendix A: E1 Frame Structure

1. PCM30/PCM31 Frame Format (ITU-T G.704/G.706)


F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15
1 frame = 32 timeslots=125μs
TS 0 TS 1 TS 2 ..... TS 15 TS 16 TS 17 ..... TS 29 TS 30 TS 31
Channels 1 to 15
Channels 16 to 30
FAS/NFAS
Network Signaling
8-bit word
Si 0 0 1 1 0 1 1
F0 0 0 0 0 x y x x
1 2 3 4 5 6 7 8
FAS Word
MFAS
NMFAS
NFAS Word
F1 a b c d a b c d
Si 1 A Sa Sa Sa Sa Sa
CH1
CH16
F2 a b c d a b c d
Sa4~Sa8
CH2
CH17
F15 a b c d a b c d
CH15
CH30

FAS word structure:

Bit 1 (Si) is reserved for international use.
The remaining bits are used for frame sync and are always set to 0011011.

NFAS word structure:

Bit 1 (Si) is reserved for international use.
Bit 2 is always set to 1.
Bit 3 of the NFAS contains the A-bit which indicates a remote (or distant) alarm (for example, far-end multiplexer out of synchronization).
Bit 3 = 0 indicates normal operation; no alarm.
Bit 3 = 1 indicates that one of the following fault conditions has occurred:

- Power supply failure
- Codec failure
- Failure of incoming 2Mb/s signal
- Frame alignment error
- Frame alignment signal error ratio > 10^{-3}.

Bit 4 ~ Bit 8:

ITU-T recommendations allow the S-bits (Sa4 to Sa8) to be used in specific point to point applications. Bit Sa4 may be used as a message-based data link for operations, maintenance and performance monitoring. The signal originates at the point where the frame is generated and ends where the frame is split up. Bits Sa5 to Sa8 are all intended for national use and when unused are set to logic 1.

Channel associated signaling (CAS):

Once the multiplexer has gained frame alignment, it searches in timeslot 16 for the multiframe alignment signal (MFAS) (0000) in bits 1 to 4. A multiframe consists of 16 frames, and 0000 in bits 1 to 4 signifies the first of these frames. The multiframe is only necessary when CAS is used (that is, PCM30). Timeslot 16 contains the information necessary for switching and routing all 30 telephone channels. The signaling between the near-end and far-end multiplexer takes place using pulse signals comprising 4 bits (ABCD). These are generated by the signaling multiplex equipment. The 64 kb/s signaling capacity of timeslot 16 is divided between the 30 telephone channels and two auxiliary channels (synchronization and alarm message), using pairs of 4-bit ABCD signaling words. Over a complete multiframe, all 30 channels are serviced. Timeslot 16 can accommodate a pair of 4-bit ABCD signaling words. This ensures that all 30 channels are serviced over a complete multiframe.

Common channel signaling (CCS):

If CCS is used, multiframe alignment is unnecessary. Timeslot 16 is simply used as a 64 kb/s data channel for CCS message, or it can be turned over to revenue-earning traffic, giving a total of 31 channels for the payload(PCM31).

Limitations of the standard framing format:

When the 2 Mb/s frame is used exclusively for PCM voice transmission, the frame alignment criteria is very reliable. However, it has some limitations, particularly for data transmission and on-line performance monitoring. With data transmission, the traffic can inadvertently simulate the frame alignment and non-frame alignment words and false framing is possible. This can have a serious effect on the data. Performance monitoring of received signal is limited to checking for errors in the frame alignment signals. This gives a poor indication of errors in the payload as only seven bits in 256 are being checked. There is no way for the remote end to send back this rudimentary error performance data, so only one direction of transmission can be monitored at each location. In an age of increasingly competitive digital leased line service, this is inadequate.

2. PCM30CRC/PCM31CRC Frame Format (ITU-T G.704)

SMF	Sub-Frame Number	TS0								TS1 ~ TS15	TS16		TS17 ~ TS31
I	0	FAS								8-bit Data	MFAS	NMFAS	8-bit Data
		C1	0	0	1	1	0	1	1		0000	XYXX	
	1	NFAS								8-bit Data	TS01	TS17	8-bit Data
		0	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	
	2	FAS								8-bit Data	TS02	TS18	8-bit Data
		C2	0	0	1	1	0	1	1		a b c d	a b c d	
	3	NFAS								8-bit Data	TS03	TS19	8-bit Data
		0	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	
	4	FAS								8-bit Data	TS04	TS20	8-bit Data
		C3	0	0	1	1	0	1	1		a b c d	a b c d	
	5	NFAS								8-bit Data	TS05	TS21	8-bit Data
		1	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	
	6	FAS								8-bit Data	TS06	TS22	8-bit Data
		C4	0	0	1	1	0	1	1		a b c d	a b c d	
	7	NFAS								8-bit Data	TS07	TS23	8-bit Data
		0	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	
II	8	FAS								8-bit Data	TS08	TS24	8-bit Data
		C1	0	0	1	1	0	1	1		a b c d	a b c d	
	9	NFAS								8-bit Data	TS09	TS25	8-bit Data
		1	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	
	10	FAS								8-bit Data	TS10	TS26	8-bit Data
		C2	0	0	1	1	0	1	1		a b c d	a b c d	
	11	NFAS								8-bit Data	TS11	TS27	8-bit Data
		1	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	
	12	FAS								8-bit Data	TS12	TS28	8-bit Data
		C3	0	0	1	1	0	1	1		a b c d	a b c d	
	13	NFAS								8-bit Data	TS13	TS29	8-bit Data
		E1	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	
	14	FAS								8-bit Data	TS14	TS30	8-bit Data
		C4	0	0	1	1	0	1	1		a b c d	a b c d	
	15	NFAS								8-bit Data	TS15	TS31	8-bit Data
		E2	1	A	Sa	Sa	Sa	Sa	Sa		a b c d	a b c d	

CRC-4 framing:

To overcome the limitations of the standard framing format issued above, ITU-T recommendation G.704 specifies that the use of a CRC-4 cyclic redundancy check for 2 Mb/s systems. CRC-4 framing provides reliable protection against incorrect synchronization and a means of monitoring bit error ratio (BER) during normal operation. In other words, CRC-4 framing

algorithm is extremely unlikely to be fooled by payload data patterns.

The CRC-4 remainder is calculated on complete blocks of data, and the 4-bit remainder is transmitted to the far-end, using the first bit in the FAS of each even numbered frame (C1-C4). At the receiving end, the receiver makes the same calculation and compares its results with those in the received signal. If the two 4-bit words differ, the receiving equipment knows that one or more errors are present in the payload. Every bit of the block is checked so an accurate estimate of block error rate (or errored seconds) is made while the link is in service.

To enable the receiver to locate the four bits C1, C2, C3, C4 forming the remainder, an additional frame called the CRC multiframe is formed. The CRC-4 multiframe comprises sub-multiframes Ⅰ and Ⅱ, both of which comprise eight normal frames. A CRC multiframe alignment signal is used to synchronize the receiver to this frame. The signal is inserted bit by bit into the first bit position of the NFAS in frames 1, 3, 5, 7, 9 and 11.

The CRC-4 multiframe alignment signal is 001011 and is transmitted in the first bit of the NFAS word. The first bits of frame 13 and 15, called E-bits are used to indicate a negative comparison (that is, data blocks with bits errors) back from the far end to the transmitter. If the E-bit in frame 13 is 0 then there is an error in sub-multiframe (SMF) Ⅰ. The E-bit in frame 15 indicates error status from sub-multiframe Ⅱ in the same way.

Each sub-multiframe in the CRC multiframe consists of eight standard PCM frames, and is 1 ms (8 x 125 μs) long. That means there are one thousand CRC-4 error checks made every second. CRC-4 error checking is very reliable, because at least 94%of errored blocks are detected.

Another powerful feature CRC-4 framing provides is the local indication of alarms and errors detected at the remote end. When an errored SMF is detected, E-bits are changed from 1 to 0 in the return path multiframe. The local end, therefore, has exactly the same block error information as the far-end CRC-4 checker. Counting E-bit changes is equivalent to counting CRC-block errors. Consequently, the local end can monitor the performance of both go and return path. This can be carried out by the network equipment itself, or by suitable test equipment, monitoring the received 2 Mb/s stream.

In the same way, the A-bits return error alarm signals for loss of frame, loss of synchronization, or loss of signal from the remote end. The CRC-4 frame structure is preferred format because of its error detection capability and immunity to false frame alignment (refer to ITU-T G.706). For systems without CRC framing, in-service testing is limited to checking for errors in the frame alignment word, which provides a poor indication of errors in the payload.

Appendix B: Datacom Adapter Cables

1. V.24 Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				DB25-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Transmitted data	TD	103	→	2
4	Transmit Clock (DTE)	XTC	113	→	24
7	Signal Ground	SGND	102		7
8	Data Terminal Ready	DTR	108	→	20
10	Request to Send	RTS	105	→	4
12	Received Data	RD	104	←	3
14	Receive Clock	RC	115	←	17
16	Clear to Send	CTS	106	←	5
18	Data Set Ready	DSR	107	←	6
20	Transmit Clock (DCE)	TC	114	←	15
22	Data Carrier Detect	DCD	109	←	8

2. V.24 Adapter Cable PIN Assignments (DCE)

DB44-male PIN (Tester)	Descriptions				DB25-female (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Received Data	RD	104	→	3
4	Transmit Clock (DCE)	TC	114	→	15
7	Signal Ground	SGND	102		7
8	Data Set Ready	DSR	107	→	6
10	Clear to Send	CTS	106	→	5
12	Transmitted Data	TD	103	←	2
14	Transmit Clock (DTE)	XTC	113	←	24
16	Request to Send	RTS	105	←	4
18	Data Terminal Ready	DTR	108	←	20
20	Receive Clock	RC	115	→	17
22	Data Carrier Detect	DCD	109	→	8

3. V.35 Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				M34-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Send Data (A)	SD(A)	103	→	P
3	Send Data (B)	SD(B)	103	→	S
4	Serial Clock Transmit External (DTE) (A)	SCTE (A)	113	→	U
5	Serial Clock Transmit External (DTE) (B)	SCTE (B)	113	→	W
7	Signal Ground	SGND	102		B
8	Data Terminal Ready	DTR	108	→	H
10	Request to Send	RS	105	→	C
12	Receive Data (A)	RD(A)	104	←	R
13	Receive Data (B)	RD(B)	104	←	T
14	Serial Clock Receive (A)	SCR(A)	115	←	V
15	Serial Clock Receive (B)	SCR(B)	115	←	X
16	Clear to Send	CS	106	←	D
18	Data Set Ready	DSR	107	←	E
20	Serial Clock Transmit (DCE) (A)	SCT(A)	114	←	Y
21	Serial Clock Transmit (DCE) (B)	SCT(B)	114	←	AA
22	Receive line Signal Detector	RLSD	109	←	F

4. V.35 Adapter Cable PIN Assignments (DCE)

DB44-male PIN (Tester)	Descriptions				M34-female (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Receive Data (A)	RD(A)	104	→	R
3	Receive Data (B)	RD(B)	104	→	T
4	Serial Clock Transmit (DCE) (A)	SCT(A)	114	→	Y
5	Serial Clock Transmit (DCE) (B)	SCT(B)	114	→	AA
7	Signal Ground	SGND	102		B
8	Data Set Ready	DSR	107	→	E
10	Clear to Send	CS	106	→	D
12	Send Data (A)	SD(A)	103	←	P
13	Send Data (B)	SD(B)	103	←	S
14	Serial Clock Transmit External (DTE) (A)	SCTE (A)	113	←	U
15	Serial Clock Transmit External (DTE) (B)	SCTE (B)	113	←	W
16	Request to Send	RS	105	←	C
18	Data Terminal Ready	DTR	108	←	H
20	Serial Clock Receive (A)	SCR(A)	115	→	V
21	Serial Clock Receive (B)	SCR(B)	115	→	X
22	Receive Line Signal Detector	RLSD	109	→	F

5. V.36 Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				DB37-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Transmitted Data (A)	TD(A)	103	→	4
3	Transmitted Data (B)	TD(B)	103	→	22
4	Transmit Clock (DTE) (A)	XTC(A)	113	→	17
5	Transmit Clock (DTE) (B)	XTC(B)	113	→	35
7	Signal Ground	SGND	102		19
8	Data Terminal Ready	DTR	108	→	12
10	Request to Send	RTS	105	→	7
12	Received Data (A)	RD(A)	104	←	6
13	Received Data (B)	RD(B)	104	←	24
14	Receive Clock (A)	RC(A)	115	←	8
15	Receive Clock (B)	RC(B)	115	←	26
16	Clear to Send	CTS	106	←	9
18	Data Terminal Ready	DSR	107	←	11
20	Transmit Clock (DCE) (A)	TC(A)	114	←	5
21	Transmit Clock (DCE) (B)	TC(B)	114	←	23
22	Data Carrier Detect	DCD	109	←	13

6. V.36 Adapter Cable PIN Assignments (DCE)

DB44-male PIN (Tester)	Descriptions				DB37-female (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Received Data (A)	RD(A)	104	→	6
3	Received Data (B)	RD(B)	104	→	24
4	Transmit Clock (DCE) (A)	TC(A)	114	→	5
5	Transmit Clock (DCE) (B)	TC(B)	114	→	23
7	Signal Ground	SGND	102		19
8	Data Set Ready	DSR	107	→	11
10	Clear to Send	CTS	106	→	9
12	Transmitted Data (A)	TD(A)	103	←	4
13	Transmitted Data (B)	TD(B)	103	←	22
14	Transmit Clock (DTE) (A)	XTC(A)	113	←	17
15	Transmit Clock (DTE) (B)	XTC(B)	113	←	35
16	Request to Send	RTS	105	←	7
18	Data Terminal Ready	DTR	108	←	12
20	Receive Clock (A)	RC(A)	115	→	8
21	Receive Clock (B)	RC(B)	115	→	26
22	Data Carrier Detect	DCD	109	→	13

7. RS-449 Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				DB37-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Send Data (A)	SD(A)	103	→	4
3	Send Data (B)	SD(B)	103	→	22
4	Terminal Timing (DTE) (A)	TT(A)	113	→	17
5	Terminal Timing (DTE) (B)	TT(B)	113	→	35
7	Signal Ground	SG	102		19
8	Terminal Ready (A)	TR(A)	108	→	12
9	Terminal Ready (B)	TR(B)	108	→	30
10	Request to Send (A)	RS(A)	105	→	7
11	Request to Send (B)	RS(B)	105	→	25
12	Receive Data (A)	RD(A)	104	←	6
13	Receive Data (B)	RD(B)	104	←	24
14	Receive Timing (A)	RT(A)	115	←	8
15	Receive Timing (B)	RT(B)	115	←	26
16	Clear to Send (A)	CS(A)	106	←	9
17	Clear to Send (B)	CS(B)	106	←	27
18	Data Mode(A)	DM(A)	107	←	11
19	Data Mode(B)	DM(B)	107	←	29
20	Send Timing (DCE) (A)	ST(A)	114	←	5
21	Send Timing (DCE) (B)	ST(B)	114	←	23
22	Receiver Ready (A)	RR(A)	109	←	13
23	Receiver Ready (B)	RR(B)	109	←	31

8. RS-449 Adapter Cable PIN Assignments (DCE)

DB44-male PIN (Tester)	Descriptions				DB37-female (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Receive Data (A)	RD(A)	104	→	6
3	Receive Data (B)	RD(B)	104	→	24
4	Send Timing (DCE) (A)	ST(A)	114	→	5
5	Send Timing (DCE) (B)	ST(B)	114	→	23
7	Signal Ground	SG	102		19
8	Data Mode (A)	DM(A)	107	→	11
9	Data Mode (B)	DM(B)	107	→	29
10	Clear to Send (A)	CS(A)	106	→	9
11	Clear to Send (B)	CS(B)	106	→	27
12	Send Data (A)	SD(A)	103	←	4
13	Send Data (B)	SD(B)	103	←	22
14	Terminal Timing (DTE) (A)	TT(A)	113	←	17
15	Terminal Timing (DTE) (B)	TT(B)	113	←	35
16	Request to Send (A)	RS(A)	105	←	7
17	Request to Send (B)	RS(B)	105	←	25
18	Terminal Ready (A)	TR(A)	108	←	12
19	Terminal Ready (B)	TR(B)	108	←	30
20	Receive Timing (A)	RT(A)	115	→	8
21	Receive Timing (B)	RT(B)	115	→	26
22	Receiver Ready (A)	RR(A)	109	→	13
23	Receive Ready (B)	RR(B)	109	→	31

9. X.21 Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				DB15-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Transmit (A)	T(A)	103	→	2
3	Transmit (B)	T(B)	103	→	9
7	Signal Ground	SG	102		8
10	Control (A)	C(A)	105	→	3
11	Control (B)	C(B)	105	→	10
12	Receive (A)	R(A)	104	←	4
13	Receive (B)	R(B)	104	←	11
14	Signal Element Timing (A)	S(A)	115	←	6
15	Signal Element Timing (B)	S(B)	115	←	13
16	Indication (A)	I(A)	106	←	5
17	Indication (B)	I(B)	106	←	12
20	Byte Timing (DCE) (A)	B(A)	114	←	7
21	Byte Timing (DCE) (B)	B(B)	114	←	14

10. X.21 Adapter Cable PIN Assignment (DCE)

DB44-male PIN (Tester)	Descriptions				DB15-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Receive (A)	R(A)	104	→	4
3	Receive (B)	R(B)	104	→	11
4	Byte Timing (DCE) (A)	B(A)	114	→	7
5	Byte Timing (DCE) (B)	B(B)	114	→	14
7	Signal Ground	SG	102		8
10	Indication (A)	I(A)	106	→	5
11	Indication (B)	I(B)	106	→	12
12	Transmit (A)	T(A)	103	←	2
13	Transmit (B)	T(B)	103	←	9
16	Control (A)	C(A)	105	←	3
17	Control (B)	C(B)	105	←	10
20	Signal Element Timing (A)	S(A)	115	→	6
21	Signal Element Timing (B)	S(B)	115	→	13

11. RS-485 Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				DB25-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Transmitted Data (A)	TD(A)	103	→	2
3	Transmitted Data (B)	TD(B)	103	→	14
4	Transmit Clock (DTE) (A)	XTC(A)	113	→	24
5	Transmit Clock (DTE) (B)	XTC(B)	113	→	11
7	Signal Ground	SGND	102		7
8	Data Terminal Ready (A)	DTR(A)	108	→	20
9	Data Terminal Ready (B)	DTR(B)	108	→	23
10	Request to Send (A)	RTS(A)	105	→	4
11	Request to Send (B)	RTS(B)	105	→	19
12	Received Data (A)	RD(A)	104	←	3
13	Received Data (B)	RD(B)	104	←	16
14	Receive Clock (A)	RC(A)	115	←	17
15	Receive Clock (B)	RC(B)	115	←	9
16	Clear to Send (A)	CTS(A)	106	←	5
17	Clear to Send (B)	CTS(B)	106	←	13
18	Data Set Ready (A)	DSR(A)	107	←	6
19	Data Set Ready (B)	DSR(B)	107	←	22
20	Transmit Clock (DCE) (A)	TC(A)	114	←	15
21	Transmit Clock (DCE) (B)	TC(B)	114	←	12
22	Data Carrier Detect (A)	DCD(A)	109	←	8
23	Data Carrier Detect (B)	DCD(B)	109	←	10

12. RS-485 Adapter Cable PIN Assignments (DCE)

DB44-male PIN (Tester)	Descriptions				DB25-female (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Received Data (A)	RD(A)	104	→	3
3	Received Data (B)	RD(B)	104	→	16
4	Transmit Clock (DCE) (A)	TC(A)	114	→	15
5	Transmit Clock (DCE) (B)	TC(B)	114	→	12
7	Signal Ground	SGND	102		7
8	Data Set Ready (A)	DSR(A)	107	→	6
9	Data Set Ready (B)	DSR(B)	107	→	22
10	Clear to Send (A)	CTS(A)	106	→	5
11	Clear to Send (B)	CTS(B)	106	→	13
12	Transmitted Data (A)	TD(A)	103	←	2
13	Transmitted Data (B)	TD(B)	103	←	14
14	Transmit Clock (DTE) (A)	XTC(A)	113	←	24
15	Transmit Clock (DTE) (B)	XTC(B)	113	←	11
16	Request to Send (A)	RTS(A)	105	←	4
17	Request to Send (B)	RTS(B)	105	←	19
18	Data Terminal Ready (A)	DTR(A)	108	←	20
19	Data Terminal Ready (B)	DTR(B)	108	←	23
20	Received Clock (A)	RC(A)	115	→	17
21	Received Clock (B)	RC(B)	115	→	9
22	Data Carrier Detect (A)	DCD(A)	109	→	8
23	Data Carrier Detect (B)	DCD(B)	109	→	10

13. EIA-530 Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				DB25-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Transmitted Data (A)	BA(A)	103	→	2
3	Transmitted Data (B)	BA(B)	103	→	14
4	Transmit Clock (DTE) (A)	DA(A)	113	→	24
5	Transmit Clock (DTE) (B)	DA(B)	113	→	11
7	Signal Ground	AB	102		7
8	Data Terminal Ready	CD(A)	108	→	20
10	Request to Send (A)	CD(B)	105	→	4
11	Request to Send (B)	CA(A)	105	→	19
12	Received Data (A)	CA(B)	104	←	3
13	Received Data (B)	BB(A)	104	←	16
14	Receive Clock (A)	BB(B)	115	←	17
15	Receive Clock (B)	DD(A)	115	←	9
16	Clear to Send (A)	DD(B)	106	←	5
17	Clear to Send (B)	CB(A)	106	←	13
18	Data Set Ready	CB(B)	107	←	6
20	Transmit Clock (DCE) (A)	CC(A)	114	←	15
21	Transmit Clock (DCE) (B)	CC(B)	114	←	12
22	Data Carrier Detect (A)	DB(A)	109	←	8
23	Data Carrier Detect (B)	DB(B)	109	←	10

14. EIA-530 Adapter Cable PIN Assignments (DCE)

DB44-male PIN (Tester)	Descriptions				DB25-female (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Received Data (A)	BB(A)	104	→	3
3	Received Data (B)	BB(B)	104	→	16
4	Transmit Clock (DCE) (A)	DB(A)	114	→	15
5	Transmit Clock (DCE) (B)	DB(B)	114	→	12
7	Signal Ground	AB	102		7
8	Data Set Ready (A)	CC(A)	107	→	6
9	Data Set Ready (B)	CC(B)	107	→	22
10	Clear to Send (A)	CB(A)	106	→	5
11	Clear to Send (B)	CB(B)	106	→	13
12	Transmitted Data (A)	BA(A)	103	←	2
13	Transmitted Data (B)	BA(B)	103	←	14
14	Transmit Clock (DTE) (A)	DA(A)	113	←	24
15	Transmit Clock (DTE) (B)	DA(B)	113	←	11
16	Request to Send (A)	CA(A)	105	←	4
17	Request to Send (B)	CA(B)	105	←	19
18	Data Terminal Ready (A)	CD(A)	108	←	20
19	Data Terminal Ready (B)	CD(B)	108	←	23
20	Received Clock (A)	DD(A)	115	→	17
21	Received Clock (B)	DD(B)	115	→	9

15. EIA-530A Adapter Cable PIN Assignments (DTE)

DB44-male PIN (Tester)	Descriptions				DB25-male (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Transmitted Data (A)	BB(A)	103	→	2
3	Transmitted Data (B)	BB(B)	103	→	14
4	Transmit Clock (DTE) (A)	DB(A)	113	→	24
5	Transmit Clock (DTE) (B)	DB(B)	113	→	11
7	Signal Ground	AB	102		7
8	Data Terminal Ready	CC	108	→	20
10	Request to Send (A)	CB(A)	105	→	4
11	Request to Send (B)	CB(B)	105	→	19
12	Received Data (A)	BA(A)	104	←	3
13	Received Data (B)	BA(B)	104	←	16
14	Receive Clock (A)	DA(A)	115	←	17
15	Receive Clock (B)	DA(B)	115	←	9
16	Clear to Send (A)	CA(A)	106	←	5
17	Clear to Send (B)	CA(B)	106	←	13
18	Data Set Ready	CD	107	←	6
20	Transmit Clock (DCE) (A)	DD(A)	114	←	15
21	Transmit Clock (DCE) (B)	DD(B)	114	←	12
22	Data Carrier Detect (A)	CF(A)	109	←	8
23	Data Carrier Detect (B)	CF(B)	109	←	10

16. EIA-530A Adapter Cable PIN Assignments (DCE)

DB44-male PIN (Tester)	Descriptions				DB25-female (Equipment Under Test)
	Circuit Name	Ab.	ITU-T Signal	Signal Direction	
2	Received Data (A)	BB(A)	104	→	3
3	Received Data (B)	BB(B)	104	→	16
4	Transmit Clock (DCE) (A)	DB(A)	114	→	15
5	Transmit Clock (DCE) (B)	DB(B)	114	→	12
7	Signal Ground	AB	102		7
8	Data Set Ready	CC	107	→	6
10	Clear to Send (A)	CB(A)	106	→	5
11	Clear to Send (B)	CB(B)	106	→	13
12	Transmitted Data (A)	BA(A)	103	←	2
13	Transmitted Data (B)	BA(B)	103	←	14
14	Transmit Clock (DTE) (A)	DA(A)	113	←	24
15	Transmit Clock (DTE) (B)	DA(B)	113	←	11
16	Request to Send (A)	CA(A)	105	←	4
17	Request to Send (B)	CA(B)	105	←	19
18	Data Terminal Ready	CD	108	←	20
20	Receive Clock (A)	DD(A)	115	→	17
21	Receive clock (B)	DD(B)	115	→	9
22	Data Carrier Detect (A)	CF(A)	109	→	8
23	Data Carrier Detect (B)	CF(B)	109	→	10

Appendix C: G.703 CO Adapter Cable

DB44-male PIN (Tester)	Descriptions			Clamps (Equipment Under Test)
	Circuit Name	Ab.	Signal Direction	
1	TxD(A)	TTIP	→	Red (Red Cable)
6	TxD(B)	TRING	→	Red (Red Cable)
24	RxD(A)	RTIP	←	Green (Green Cable)
25	RxD(B)	RRING	←	Green (Green Cable)

Appendix D: Special Adapter Cables

Code	Item Description	Applying Interfaces	Connector
XGA1008	Datacom Special Adapter Cable Ⅰ (DTE, DCE)	V.24, RS-485, EIA-530, EIA-530A	DB25
XGA1009	Datacom Special Adapter Cable Ⅱ (DTE, DCE)	RS-449, V.36	DB37
XGA1010	Datacom Special Adapter Cable Ⅲ (DTE, DCE)	X.21	DB15
XGA1011	Datacom Special Adapter Cable Ⅳ (DTE, DCE)	V.35	M34
XGA1012	G.703 CO Special Adapter Cable	G.703 CO	Clamps

Appendix E: Abbreviation

AIS	**Alarm Indication Signal**
AMI	**Alternate Mark Inversion**
BBE	**Background Block Error**
CAS	**Channel Associated Signaling**
CCS	**Common Channel Signaling**
CODE	**Code**
CRC	**Cyclical Redundancy Check**
DM	**Degraded Minutes**
EB	**Error Block**
EFS	**ERR Free Seconds**
ER	**Error**
ES	**Errored Second**
FAS	**Frame Alignment Signal**
HDB3	**High Density Bipolar3**
MF	**Multi-frame**
MFAS	**Timeslot 16 for the multiframe alignment signal (MFAS) (0000) in bits 5 to 8.**
MF0TS16	**Timeslot 16 for the F0 sub-frame of multi-frame**
N-FAS	**Unframed Signal**
NMFAS	**Timeslot 16 for the multiframe alignment signal (NMFAS) (XYXX) in bits 1 to 4.**
PCM	**Pulse-code Modulation**
REBE	**Remote End Block Errors**
SES	**Severe Errored Second**
SMF	**CRC Sub-Multiframe**
UNAVA	**Unavailability**